MARICOPA ASSOCIATION of GOVERNMENTS

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May 15, 2008

TO: Members of the MAG Regional Council

FROM: Lindy Bauer, MAG Environmental Director

SUBJECT: MATERIAL FOR THE SMALL PLANT REVIEW AND APPROVAL FOR THE PRESERVE AT GOLDFIELD RANCH WATER RECLAMATION FACILITY

For your information, we are forwarding a report prepared for the Salt River Pima-Maricopa Indian Community regarding the Small Plant Review and Approval for the Preserve at Goldfield Ranch Water Reclamation Facility. Also enclosed is a letter we have received from the Arizona Department of Environmental Quality regarding the Goldfield Facility and the MAG 208 Water Quality Management Plan process.

This information is scheduled to be reviewed by the MAG Water Quality Advisory Committee at their May 22, 2008 meeting. Following the review by the Committee, it is anticipated that the Preserve at Goldfield Ranch Water Reclamation Facility will be considered at the May 28, 2008 Regional Council meeting.

If you have any questions, please contact me or Julie Hoffman, MAG Environmental Planner III, at the MAG office.

cc: MAG Management Committee

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

1110 West Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.azdeq.gov

Janet Napolitano
Governor

Stephen A. Owens
Director

May 13, 2008

Lindy Bauer, Environmental Director
Maricopa Association of Governments
302 North 1st Avenue, Suite 300
Phoenix, AZ 85003

Re: The Preserve at Goldfield Ranch Section 208 Review

Dear Ms. Bauer:

As you know, the Arizona Department of Environmental Quality (ADEQ) administers the Clean Water Act Section 208 water quality management planning process in Arizona. Through the Governor's designation, Councils of Government, such as the Maricopa Association of Government (MAG), provide local review of proposed municipal wastewater projects to determine consistency with the local and state water quality management general plan. ADEQ has approved MAG's October 2002 Water Quality Management Plan, which outlines the substantive and procedural requirements for MAG and ADEQ approval of a municipal wastewater project.

We understand that the MAG Regional Council may act on the Section 208 Small Plant Process review of The Preserve at Goldfield Ranch (the project) at its meeting on May 28, 2008. We have been contacted by both the Salt River Pima-Maricopa Indian Community and the Fort McDowell Yavapai Nation regarding their concerns about the proposed project. We have learned that MAG's Water Quality Advisory Committee, on March 20, and MAG's Management Committee, on April 9, have passed the project despite letters of concern issued in December 2007 by both communities and presentations by both communities at the March 20 and April 9 MAG subcommittee meetings in which the communities raised a number of concerns about the project that have not been addressed to their satisfaction.

MAG's approved October 2002 Water Quality Management Plan states: "Projects within three miles of a Municipal Small Plant Planning Area would be reviewed and commented on by the affected City or Town. Projects with major problems to the City or Town which could not be resolved, would not receive compliance from ADEQ." Both tribal communities have MAG-designated Municipal Planning Areas within three miles of the project. Therefore, it is ADEQ's expectation that the water quality management related concerns of the two tribal communities will be resolved by the project proponent and the project sponsor (Maricopa County) before the Regional Council approves the project and submits it to ADEQ. In accordance with our rules, ADEQ will not process the Aquifer Protection Permit for the project until such objections are resolved and approved by the Regional Council. *See* Arizona Administrative Code R18-9-A201(B)(6).

Please share this information with Regional Council members. If you have any questions, please feel free to contact me at (602) 771-2303, or Water Quality Division Deputy Director, Linda Taunt, at (602) 771-4416.

Sincerely,

Joan Card

Joan Card, Director
Water Quality Division

cc Brian Davidson, ADEQ Tribal Liaison

SRP-MIC

Goldfield Ranch Small Plant Review Technical Support

Executive Summary

Final Report: May 15, 2008

Prepared for:

Salt River Pima-Maricopa Indian Community

Prepared by:

HDR Engineering, Inc

3200 E Camelback Road, Suite 350

Phoenix, Arizona 85018

Registered Professional Engineer (Civil)
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Date Signed 5/15/08
ARIZONA U.S.A.

Expires 3/31/2010

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1.0 Executive Summary

1.1 Purpose

HDR Engineering, Inc. (HDR) was hired by the Salt River Pima-Maricopa Indian Community (SRP-MIC) to provide third party technical review services of the Small Plant Review and Approval request to the Maricopa Association of Governments (MAG) for the proposed water reclamation facility associated with The Preserve at Goldfield Ranch.

1.2 Summary Assessment

It is HDR's assessment that wastewater collection and treatment for the entire area (The Preserve and Goldfield Ranch) is in the best interest of Maricopa County and all users and beneficiaries of the Verde River. The proposed plant should not be considered in a similar manner as other Small Plants that have been approved that are serving relatively flat areas away from perennial streams. The potential for surface water impairment with raw sewage is much higher than with other plants because of the steep topography and proximity of the plant to the Verde River. It is our judgment that the proposed plan for on-site treatment (septic systems) for parcels C and D is not in the best interest of the protection of regional water quality. Available hydrogeologic information is inconclusive regarding an impeding layer that would prevent injected reclaimed water from reaching the subflow of the Verde River. If the injected reclaimed water reached the subflow of the Verde River, it would need to meet surface water quality standards for the respective reach of the river. Finally, the proposed collection system, treatment plant, reclaimed water distribution system, and management of excess reclaimed water by injection will be expensive to operate, maintain, repair, and replace for a County Improvement District (CID) that will rely heavily on approximately 1,000 single-family home sites.

The MAG 208 *Water Quality Management Plan* is the County's first defense against degradation of water quality. It is entirely appropriate and expected that

MAG would apply increased scrutiny to a proposed plant that will be owned and operated by a CID, is very close to a valuable perennial stream, and for which there is limited ability to cost-effectively mitigate service failures to prevent raw sewage from entering the river. At a minimum, according to the intent of the MAG 208 planning process, the plant should be planned and sized to treat sewage from the entire area, and further assessment regarding the categorization of the plant (based on the potential for Verde River water quality impacts) should be made before MAG approves the plant for amendment into the *Water Quality Management Plan.* Regional wastewater collection and treatment is the best approach to protecting water quality, and more consideration needs to be given to the risks posed by the location of the proposed plant and the nature of the wastewater flow and quality characteristics it may be processing on startup or in the future.

1.3 Discussion

For Small Plants outside of Municipal Planning Areas (MPAs) to be approved for inclusion in the MAG 208 *Water Quality Management Plan* and construction, the following general criteria must be met:

- The Applicant must obtain the review and comment of any municipality whose Small Plant planning Area is within 3 miles of the proposed plant location or service area.
- The proposed plant must not adversely affect the operation or financial structure of existing or proposed wastewater treatment plants.
- The proposed plant must be consistent with State and County regulations and other requirements.
- The proposed plant must otherwise be consistent with the MAG 208 Plan.
- The proposed plant must be either evaluated and approved or it must be modified by the Maricopa County Environmental Services Department.

A number of specific criteria for the assessment of feasibility for a Small Plant outside of an MPA also exist. This report provides a detailed review of the

Applicant's response to each criterion, as well as a review of the SRP-MIC's concerns, and HDR's assessment of Applicant's compliance with the MAG 208 review criteria. As of May 15, 2008, five interrelated issues relevant to the protection of water quality remain unresolved by the Applicant, and, therefore, render the proposed plant inconsistent with the MAG 208 *Water Quality Management Plan*:

- Plant location and local features
- Service area
- On-site treatment
- Potential surface water quality impacts from injection
- Owner/Operator financial capability

1.3.1 Plant Location and Local Features

The unique features of the proposed plant's location relative to the Verde River, the surrounding topography, and the increased risk it poses to surface water quality standards established for the protection of wildlife and humans have not been adequately considered. While the proposed plant will have redundant power supply and on-site retention, a service failure of it or of the associated sewage lift stations throughout the community (which are not proposed to have redundant power or retention) would result in a sewage overflow that could make its way to the Verde River. The proposed plant location is 2.5 miles and 210 feet in elevation from the Verde River. At build-out capacity, unimpeded wastewater overflows from the proposed plant could reach the river within 6 to 18 hours of plant failure.

1.3.2 Service Area

The intent of the MAG 208 review process, as set forth by Section 208 of the Clean Water Act (CWA), is to protect water quality through a regional planning process. The MAG 208 process has also incorporated Growing Smarter Legislation principles to strengthen the regional planning role of MAG for multiple benefits to current and future generations of inhabitants. The *Water*

Quality Management Plan and related amendment process for Small Plants is intended to prevent the "uncontrolled proliferation of Small Plants that could cause problems in the future." The proposed plant will serve a limited area within a larger and completely enveloped county island containing existing development with septic systems and plans for additional development (including the Grayhawk proposed development west of Goldfield Ranch) that will require or could benefit from sewer collection and treatment. Not providing sewer service to the entire area will encourage the proliferation of Small Plants and septic systems in the area that increase the risk to regional water quality.

1.3.3 On-Site Treatment

The proposed plant will receive wastewater from residential and commercial properties. The Applicant has indicated that at least one commercial facility, a resort/spa, may be included. Land along State Route 87 will be highly desirable for commercial facilities, because these are the last opportunity for such facilities for travelers leaving the urban core and the first opportunity for those entering the urban core, along the highway. The Applicant currently proposes that parcels C and D, which will be the most desirable for commercial facilities, will be served by septic systems (on-site treatment). The Applicant states an intention to develop parcels C and D with single-family home sites in excess of 1 acre. However, Special Use Permits can be obtained from Maricopa County and can be used to respond to consumer demand, to effectively change the zoning and land use from residential to commercial. Such changes are not subject to review by the MAG 208 process. Regardless of what type of development occurs along State Route 87 on parcels C and D, use of septic systems as the on-site wastewater treatment technology is not a sound plan for protection of regional water quality. However, inclusion of significant commercial wastewater flows into the proposed plant will likely cause wide fluctuations in influent wastewater quality that may challenge the treatment capabilities of the proposed biologically active plant.

1.3.4 Potential Surface Water Quality Impacts from Injection

The proposed water reclamation facility at The Preserve at Goldfield Ranch initially appears to meet the criteria for a Small Plant (less than 2.0 MGD and not requiring a CWA discharge permit) that is outside of an MPA but within 3 miles of cities or towns that have Small Plant planning areas. In Arizona, the CWA discharge permit is called an Arizona Pollutant Discharge Elimination System permit, or "AZPDES" permit, and is used to maintain and avoid degradation of surface water quality.

Management of the unusable portion of the proposed plant's reclaimed water through injection wells will require compliance with surface water quality standards if it is demonstrated that the injected water mixes with the subflow of the Verde River. That is, production of Class A+ reclaimed water will not be sufficient, if this is the case. Review of hydrogeologic data from the Arizona Department of Water Resources (ADWR) and Salt River Project (SRP) indicates that the existence of a continuous clay layer that would prevent or retard injected Class A+ reclaimed water from entering the Verde River is inconclusive. Further, the analysis of the 72-hour aquifer test conducted in 1985 at The Preserve at Goldfield Ranch reveals a response more typical of a leaky confined aquifer or proximity of a recharge boundary, not of a confined aquifer. In this circumstance, ADEQ will likely require compliance with surface water quality criteria for the reach of the Verde River into which the discharge would be received. At ADEQ's discretion, these criteria could become part of the Applicant's Aquifer Protection Permit (APP), or could be implemented through a separate AZPDES permit. In either case, the potential exists for surface water quality standards (derived from the CWA) to be included in a permit. Therefore, a determination needs to be made at this point in the planning process if the Goldfield WRF meets the MAG 208 small plant designation before an application for amendment to the MAG 208 *Water Quality Management Plan* can be made.

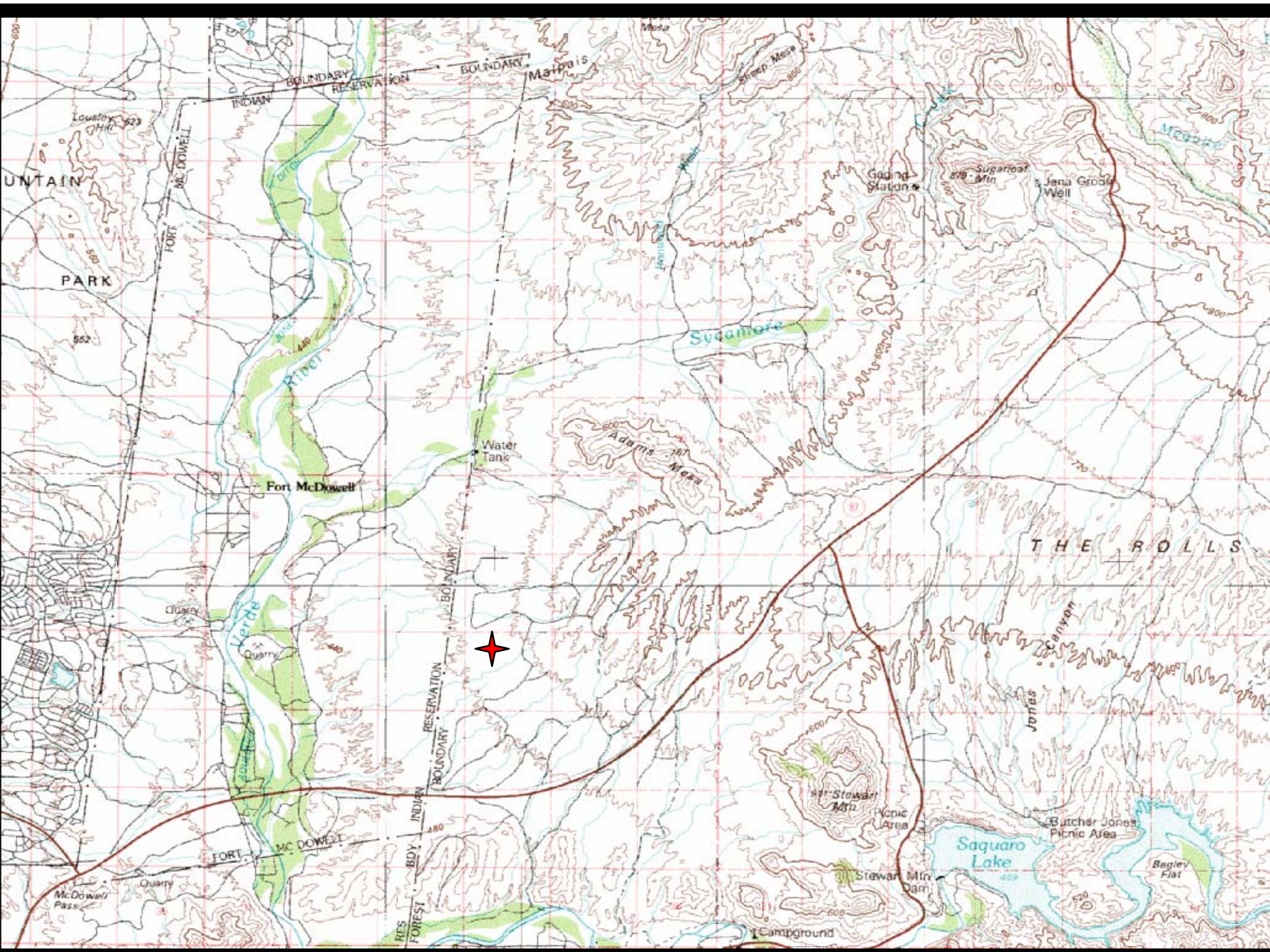
1.3.5 Owner/Operator Financial Capability

While the Applicant has demonstrated financial capability to build the plant, the operation, maintenance, and repair and replacement of infrastructure and appurtenances for the collection system, plant, and the distribution (reuse) and management (injection and recovery) system of reclaimed water will be relatively expensive for a CID made up largely of residential customers (approximately 1,000 service connections) to continuously fund. For example, if an aquifer storage and recovery well (as is implied by Applicant's Figure 5) were to fail and need to be replaced, it would cost the CID approximately $1 million to replace it. Based on historical performance of wells in the Maricopa County area, injection wells need to be rehabilitated every 3 to 5 years at an average cost of $100,000. Also, the increased risk to surface water quality translates to an increased risk of violation and fines imposed on the CID. The Applicant has stated that the developer will supplement the financial security of the CID, but does not indicate for how long. Regardless, this issue does not appear to be adequately addressed by the Applicant, and there appears to be the potential for a significant financial burden to the future CID.

1.4 Conclusion

While the Applicant has successfully addressed some of the issues pertinent to the MAG 208 process, there are key components in the application that have not been adequately addressed. Consequently, the application is inconsistent with the MAG 208 *Water Quality Management Plan.*

Goldfield Ranch Small Plant Review
Technical Support
Final Report
May 15, 2008



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SRP-MIC

Goldfield Ranch Small Plant Review Technical Support

Final Report: May 15, 2008

Prepared for:

Salt River Pima-Maricopa Indian Community

Registered Professional Engineer (Civil)
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ACRONYMS AND ABBREVIATIONS

AAC	Arizona Administrative Code
ACC	Arizona Corporation Commission
ADEQ	Arizona Department of Environmental Quality
ADWR	Arizona Department of Water Resources
APP	Aquifer Protection Permit
ASR	Aquifer Storage and Recovery
AZPDES	Arizona Pollutant Discharge Elimination System
CID	County Improvement District
CWA	Clean Water Act
FMYN	Fort McDowell Yavapai Nation
MAG	Maricopa Association of Governments
MCESD	Maricopa County Environmental Services Department
MPA	Municipal Planning Area
NPDES	National Pollutant Discharge Elimination System
SRP	Salt River Project
SRPMIC	Salt River Pima Maricopa Indian Community

1.0 Introduction

The Salt River Pima-Maricopa Indian Community (SRP-MIC) has identified a number of concerns relating to the proposed Water Reclamation Facility (WRF) for the planned development, entitled The Preserve at Goldfield Ranch (Applicant). SRP-MIC has contracted with HDR Engineering, Inc. (HDR), to provide professional engineering and hydrogeological consulting services to provide third-party review of its concerns. HDR subcontracted with HydroSystems, Inc. (HSI), for the hydrogeologic services.

1.1 Purpose

The purpose of this report is to:

- Provide third-party technical review of the Applicant's adherence to the MAG 208 *Water Quality Management Plan* amendment criteria
- Evaluate the Applicant's response to concerns raised by the SRP-MIC
- Identify and document any additional technical concerns with regard to the Applicant's MAG 208 amendment request
- Summarize findings and draw conclusions regarding Applicant's compliance with the MAG 208 *Water Quality Management Plan* amendment criteria

1.2 Background

1.2.1 Section 208 of the Clean Water Act (CWA)

The MAG 208 process is a result of recommendations in Section 208 of the CWA. The CWA, which was passed in 1972, has been one of the most important pieces of environmental legislation for the protection of water quality in nation's rivers, lakes, estuaries, and wetlands. Protecting the quality of the nation's surface water involves regulating wastewater treatment and discharges and appropriate regional planning to wastewater treatment. Section 208 of the CWA encourages the development and implementation of areawide waste treatment management plans.

Section 208 stipulates that the regional waste water treatment management plans identify the anticipated municipal and industrial waste treatment needs in the area for a 20-year period and the treatment works necessary to meet those needs. The plan is to include processes to control the disposal of pollutants to protect ground and surface water quality. It authorizes a regulatory program to:

- Implement waste treatment management requirements of section 201(c)
- Regulate location, modification, and construction of any facilities which may result in any discharge in such area
- Ensure that industrial or commercial waste discharged into any treatment works meets applicable pretreatment requirements

1.3 MAG 208 Water Quality Management Plan

1.3.1 Structure and Purpose

The MAG 208 Water Quality Management Plan was first adopted in 1979. Now in effect is the second revision, adopted in 2002. The Plan was developed in response to the CWA Section 208 requirement that each state operate a continuing areawide waste treatment management planning process. For Maricopa County, the Maricopa Association of Governments (MAG) has been designated as the areawide water quality management planning agency. The planning process is a mechanism to identify specific areawide waste treatment and water quality management.

The Plan has two major elements: the Point Source Plan and the Non-Point Source Plan. The Point Source Plan is intended to “identify the preferred wastewater collection and treatment, and effluent reuse or disposal systems for the study area.” The Non-Point Source Plan was implemented in an effort to control all pollutant discharges that do not originate from a specific single location.

The MAG 208 planning process incorporates the efforts of several agencies. The United States Environmental Protection Agency (USEPA) is charged with overseeing the program to ensure the requirements and goals of Section 208 of the CWA. The Arizona Department of Environmental Quality (ADEQ) reviews and enforces the water quality standards. At the local level, cities, towns and tribal communities are responsible for planning and providing necessary collection and treatment facilities. The Maricopa County Environmental Services Department (MCESD) contributes to the process by issuing approvals to construct and approvals to operate wastewater treatment facilities located in Maricopa County.

The current *Water Quality Management Plan* acknowledges Arizona's Growing Smarter legislation as foundational for integrated planning, in concert with the MAG 208 process.

1.4 Growing Smarter Legislation

Recent legislation in Arizona has established roles for local and state government in planning and managing growth of urban areas. The Growing Smarter Act of 1998 (HB 2361), the Growing Smarter Plus Act (Senate Bill 1001), and the Growing Smarter Oversight Council Bill (HB 2601) affect how MPA (MPA) extend infrastructure to new development.

The recent bills amend existing planning and zoning legislation for Arizona. In general, the Growing Smarter Act requires municipalities and counties to adopt 10-year general plans to guide future development. The Arizona State Land Department is also required to create plans to coordinate with municipal and county plans and consider open space planning. Any general plan updates must be adopted by a planning commission, council, and a majority vote of registered voters. In addition a water resource element must be included in the plan to consider the physical and legal availability of water supplies for the projected demand over the planning horizon.

The Growing Smarter Legislation has been critical in facilitating planning coordination among the municipalities, counties, and State Land Department. The water resource element attempts to address planning needs to meet the growing population's water demands.

1.5 Amendment Approval Process

An approval process was developed to avoid revising the MAG 208 Plan each time a new plant was proposed and accepted. This process applies to any plant not already identified in the Point Source Plan of the MAG 208 Plan. The Point Source Plan was created to compile the preferred wastewater collection and treatment system for Maricopa County through the year 2020.

Plants are differentiated by size and permit requirements. A Small Plant is defined as having an ultimate capacity less than 2.0 million gallons per day (MGD) and not requiring National Pollutant Discharge Elimination System (NPDES) permit or, in Arizona's case, the Arizona Pollutant Discharge Elimination System (AZPDES) permit.

The Small Plant approval process is intended to avoid "an uncontrolled proliferation of Small Plants that could cause problems in the future." The approval process is described in Section 4.5 of the MAG 208 *Water Quality Management Plan*. The approval processes are similar for Small Plants proposed within or outside an MPA, with variation in the evaluation criteria. The MAG 208 approval process for a Small Plant outside an MPA is described below:

- An engineering report is submitted by the applicant to Maricopa County and any Cities (including tribal communities) whose Municipal Small Plant Planning Areas are within 3 miles of the proposed plant's service area. The information contained in the report will be evaluated based on the criteria in the MAG 208 Small Plant Approval Process, as summarized in Tables 1 and 2 of this report.
- The involved Cities send a letter of their recommendations to Maricopa County.

- Maricopa County incorporates the Cities' concerns in a letter and summary of the proposal to MAG with its determination regarding the proposal's acceptability.
- The MAG Water Quality Advisory Committee evaluates the proposal for overall conformance to the MAG 208 Plan to ensure the Small Plant Process is followed and to ensure all regional impacts are addressed. Its recommendations are presented to the MAG Management Committee. The MAG Management Committee reviews the proposal and presents a recommendation to the Regional Council. Once the Regional Council approves the amendment, a letter of 208 compliance is submitted to Arizona Department of Environmental Quality (ADEQ).
- ADEQ reviews the MAG submittal and sends a letter to MCESD indicating 208 Plan compliance.
- After the receipt of a 208 Plan compliance approval letter from ADEQ, MCESD reviews the plans and specifications based on Arizona Department of Health Services Engineering Bulletin #11. MCESD issues a permit to construct when its requirements for approval have been met.

Of particular importance and interest to SRP-MIC is that the MAG 208 *Water Quality Management Plan* states, "projects with major problems to the City or Town which could not be resolved, would not receive compliance from ADEQ."

1.6 Recent Small Plant Amendment Approvals

1.6.1 The Estates at Lakeside

The Estates at Lakeside is located in the City of Peoria's MPA, and is now owned and operated by the City of Peoria. This Small Plant was approved by the MAG Regional Council in March 2006. The Estates at Lakeside is an activated sludge wastewater treatment plant with an ultimate capacity of 120,000 gpd (ESCA, 2006). This plant will be constructed in two phases to serve the Estates at Lakeside subdivision; each phase has a 60,000 gpd design flow. The treated effluent will be disposed of by deep-well injection into the aquifer. Hydrogeologic analysis was provided to Arizona Department of Water Resources (ADWR) and considerations presented in the Aquifer Protection Permit (APP) application are also included in the submittal. The plant is near the Agua Fria River below Waddell Dam (forming Lake Pleasant), which is an ephemeral stream when releases from Waddell Dam allow it to flow. This reach of the Agua Fria River is designated by ADEQ as appropriate for partial body contact, but not as a domestic water source.

1.6.2 The Ruth Fisher School

The Ruth Fisher School is located in Tonopah but outside of any MPA in Maricopa County and has a Small Plant for sewage treatment. This Small Plant originally produced 15,000 gpd and Class B reclaimed water. The application for expansion to 42,000 gpd was approved by the MAG Regional Council in January 2005 (Fluid Solutions 2004). The expansion included upgrading the treatment technology for production of Class A+ quality reclaimed water. The water will be reused for irrigation and landscaping at the school with any remaining effluent recharged into the aquifer using infiltration chambers. A design concept report for the proposed treatment plant is included in the submittal to MAG. There is very little slope to the land in the area, and the plant is several miles from the closest surface water, the Gila River. Additionally, the plant was not within 3 miles of any other City's MPA.

HDR compared the previous amendment approvals of these two recent Small Plants to the Goldfield Preserve application. In general, additional information was submitted in support of the previous applications including design reports, APP applications, and more specific and direct responses to the technical evaluation criteria set forth by MAG. Although, not required by the Small Plant Process, this additional information may have been helpful in answering specific questions about the proposed reclamation facility.

2.0 Compliance of Applicant’s Request to MAG 208 Amendment Requirements

To facilitate its review, HDR developed tables that describe the MAG 208 amendment general and specific criteria, the Applicant’s response to the criteria, and HDR’s assessment of the Applicant’s compliance with the criteria. Table 1 addresses the general criteria. Table 2 addresses the specific criteria.

Table 1: General Assessment for Compliance of the Goldfield Water Reclamation Application to MAG 208 Criteria

	MAG 208 Criteria	Addressed by Applicant	HDR Assessment
1	Have the review and comment of any municipality whose Small Plant Planning Area is within three miles of the proposed plant location or service area.	Yes	The Applicant has received comment from municipalities with MPA within 3 miles of the proposed site. However, many of the comments and questions are still unresolved.
2	Not adversely affect the operation or financial structure of existing or proposed wastewater treatment plants.	No	The application does not address the impact to other existing wastewater treatment plants.
3	Be consistent with State and County regulations and other requirements.	Yes	The application includes a number of appropriate permits that will be required to operate the WRF.
4	Be otherwise consistent with the MAG 208 Plan.	No	The Goldfield WRF is not consistent with the MAG 208 Plan since it does not take into account private lands that could be served by the plant. It also does not take into account the unique features of the location and potential impacts to the Verde River.
5	Be evaluated and approved, or modified by MCESD.	Yes	MCESD has commented "no conflict."

Table 2: Specific Assessment of Compliance with MAG 208 Small Plant Approval Amendment

		MAG 208 Criteria	Addressed by Applicant	HDR Assessment
Technical Criteria				
1		**Why is a small plant desired?**	Yes	A Small Plant is more desirable in this instance, but limiting the Small Plant service area is inconsistent with the intent of the MAG 208 process.
	a	Depth to groundwater less than ___ ft.	No	Not specifically addressed in the body of the application. However, the hydrogeology report includes a figure that identifies water levels for wells within the project area.
	b	Soil Limitations prevent use of septic tanks	No	Not addressed; however, soil limitations do not appear to prevent the use of septic tanks but from a water quality standpoint a Small Plant is more desirable.
	c	Potential for reuse or water conservation	Yes	Criteria have been adequately addressed.
	d	Lot size one acre or less	Yes	Some lot sizes are greater than 1 acre.
	e	Area not planned for regional service for ___ years	Yes	Application states that the WRF substitutes for a WWTP. Limited discussion of service area of WWTP included in 1995 area plan.
	f	Density of projected population	Yes	Does not take into account the potential growth for the remaining private land.
	g	Will serve industrial or commercial area	No	WRF receives domestic and commercial wastewater.
2		**What is the anticipated quality of the wastewater?**	Yes	Does not address the quality of wastewater from the commercial uses.
	a	Domestic	Yes	Adequately addressed for service area.
	b	Commercial and/or Industrial	No	Not addressed.
	c	If commercial and/or industrial wastes are anticipated, what provisions are being taken to ensure no toxic substances will be discharged?	No	Not addressed.

Table 2: Specific Assessment of Compliance with MAG 208 Small Plant Approval Amendment (Continued)

		MAG 208 Criteria	Addressed by Applicant	HDR Assessment
3		**How and why was a small plant design and capacity selected?**	Yes	Discussion of the design and capacity is addressed but does not incorporate all private lands.
	a	What criteria were used?	Yes	Adequately addressed.
	b	What alternatives were considered?	Yes	Adequately addressed.
	c	What are benefits, problems of alternatives?	Yes	Adequately addressed.
	d	Will there be problems meeting State or County regulations?	Yes	Does not consider possibility of AZPDES permit or surface quality requirements.
	e	What sludge management options were considered?	Yes	Limited options were discussed. Who will be hauling the sludge? What plant will be accepting the sludge?
Planning Criteria				
1		**Is proposed plan compatible with County adopted master plans, guidelines, etc., for the area?**	Yes	The application addresses this by considering the 1995 adopted MC plan. However, the WRF does not include adjacent private property for service.
	a	What plans apply?	Yes	Adequately addressed.
	b	What guidelines or policies apply?	Yes	Misses the intent of the CWA Section 208, nonproliferation of small wastewater plants and regional planning.
2		**Can the proposed plant be expanded to serve growing population?**	Yes	Applicant addresses this issue by saying "limited." There is sufficient land to increase the capacity. Use of membrane bioreactor could increase the capacity with the same land area.
	a	What population is projected for the service area?	Yes	Applicant addresses this issue but does not take into account the larger potential service area of the private lands. MC plan indicates population could range between 3,500 and 7,000 at build-out (Goldfield Area Plan, 2007).
	b	What certain areas lend themselves, topographically or hydrologically, by planned use or density to being included in the service area?	Yes	Not adequately addressed. See 2a.
3		**Will proposed plant adversely impact existing or approved nearby land uses?**	No	Not addressed sufficiently.
	a	What are land uses within ___ miles?	Yes	Limited discussion.
	b	What is zoning for surrounding area?	Yes	Adequately addressed.
	c	What are reactions of nearby landowners to proposed facility?	Yes	Not adequately addressed.

Table 2: Specific Assessment of Compliance with MAG 208 Small Plant Approval Amendment (Continued)

		MAG 208 Criteria	Addressed by Applicant	HDR Assessment
4	**Will there be a net water saving from effluent reuse?**		Yes	Adequately addressed.
	a	How will effluent be disposed of?	Yes	There is not sufficient information to state that the injection wells will not affect the Verde River and the nearby wells.
	b	What is the estimated water saving?	Yes	Adequately addressed.
5	**Do nearby existing or proposed land uses indicate a need for larger capacity sewage plant than that proposed?**		Yes	Not adequately addressed. See 2a.
	a	Should nearby areas be sewered or otherwise join the proposed plant for water quality or economic reasons?	Yes	Not adequately addressed. Plan should include for plant expansion and service connection for the entire county island at build-out.
	b	Do these areas wish to join the proposed plant?	No	Have surrounding homeowners been made aware of the possibliity of connecting to a plant? What public relations activities have been conducted to inform property owners of the plant?
Development Criteria				
1	Who will fund the construction?		Yes	Adequately addressed.
2	Who will fund operation and maintenance costs?		Yes	How will a CID afford the O&M on this complex system?
3	Is there adequate financial security to assure continual and proper operation and maintenance?		No	This is addressed as financial security of Goldfield Preserve Development LLC but not of the CID that will be ultimately maintaing the system.
4	Who will operate and maintain the plant and system?		Yes	References provided for other WRFs, but operator does not show experience with injection wells. Operator resides 3 hrs from the proposed site and would be required to inspect the facility daily.
5	What are the anticipated capital and operation and maintenance costs?		Yes	Not appropriately sized for area needs.Lack of appropriate O&M costs. What will be the real costs?

3.0 SRP-MIC Concerns Regarding Applicant's Amendment Request

3.1 Clay Layer

The hydrogeology at the Goldfield site consists of the Alluvial Floodplain Aquifer, which overlays the Pemberton Ranch Formation and the Needle Rock Formation (regional aquifer).

> The Pemberton Ranch Formation composed predominantly of siltstone, claystone and fine-grained sandstone also contains minor coarse-grained sandstone and conglomerate is considered an aquiclude/aquitard confining groundwater in the predominantly subjacent Needle Rock Formation…The extension and thickness of the Pemberton Ranch Formation is important for determining the possible hydraulic connection of the Alluvial Floodplain Aquifer and the Needle Rock Formation. If the fine grained unit is absent in the mountain front edges of the basin, as is frequent in other southern Arizona basins, direct recharge from runoff can take place directly to the regional aquifer (HSI 2008, p.5).

Three wells located on the northwest corner of Parcel A of the Preserve at Goldfield Ranch intersect 250 feet of silty clay at a 400-foot depth. The figures in the Applicant's Hydrological Study (Southwest Ground-water Consultants 2006) estimate the Pemberton Ranch Formation across the entire property. The Applicant assumes that the aquifer to receive the reclaimed injected water is confined and will not impact the nearby Verde River.

However, HSI review of numerous drillers' logs from The Preserve at Goldfield Ranch and adjacent areas concludes there is "insufficient good-quality information to map with sufficient reliability the extent of the Pemberton Ranch Formation" (HSI 2008) as the Applicant has done. In addition, analysis of the 72-hour aquifer test of The Preserve at Goldfield Ranch shows a response more typical of a leaky confined aquifer or proximity of a recharge boundary, which is contrast with the Applicant's assumption. Others such as Salt River Project (SRP) believe there is hydrologic connectivity between the two aquifers at the proposed site (SRP letter, April 8, 2008). Because of these conclusions, there is sufficient evidence to require additional investigation. See Appendix A – Hydrologic Data Evaluation for recommended subsurface investigation.

3.2 Treatment Levels

The developer claims the treatment technology proposed for the plant will provide treatment to below ADEQ standards for four constituents. Treating to a water quality level that is lower than these ADEQ standards is what is expected. Of material importance is whether the proposed technology can be shown to produce an effluent quality that meets the water quality criteria for the intended reuse or discharge. For the purpose of beneficial reuse, the developer has considered four variations of activated sludge processes to produce Arizona Class A+ reclaimed water. However, it cannot be ascertained from the Applicant's text or conceptual site plan whether a denitrification step is to be included. The "+" for Arizona Class A+ and Class B+ reclaimed water is in reference to water that contains less than 10mg/L nitrate as nitrogen. This notwithstanding, it is common practice to include an anoxic zone or other treatment process in association with the proposed treatment processes to achieve the water quality standards of Class A+ reclaimed water.

The water quality standards for Class A+ water are as follows (AAC, 2003):

1. The turbidity of Class A+ reclaimed water at a point in the wastewater treatment process after filtration and immediately before disinfection complies with the following:
   a. The 24-hour average turbidity of filtered effluent is two NTUs or less, and
   b. The turbidity of filtered effluent does not exceed five NTUs at any time.
2. Class A+ reclaimed water meets the following criteria after disinfection treatment and before discharge to a reclaimed water distribution system:
   a. There are no detectable fecal coliform organisms in four of the last seven daily reclaimed water samples taken, and
   b. The single sample maximum concentration of fecal coliform organisms in a reclaimed water sample is less than 23 / 100 ml.

c. If alternative treatment processes or alternative turbidity criteria are used, or reclaimed water is blended with other water to produce Class A+ reclaimed water under subsection (C), there are no detectable enteric virus in four of the last seven monthly reclaimed water samples taken.

3. The 5-sample geometric mean concentration of total nitrogen in a reclaimed water sample is less than 10 mg / L.

HDR is confident the proposed treatment technologies, with the addition of nitrogen removal technology, are capable of producing Class A+ reclaimed water. If the Applicant intends to produce Class A+ reclaimed water quality, ADEQ will require the addition of nitrogen removal technology for the APP. The following is a summary of the treatment processes considered by the Applicant:

3.2.1 Sequencing Batch Reactors

The batch process means all biological treatment occurs in a single tank. Sequencing batch reactors are two or more reactor tanks operated in parallel or an equalization tank and a reactor tank. This process allows for several types of systems: continuous influent/time based, noncontinuous influent/time based, volume based, intermittent cycle system using jet aeration, and various other modifications. Sequencing batch reactor plants are typically manufactured to handle flow rates of 0.01 to 0.2 MGD, and can be installed in parallel modules. This type of process has a large operational flexibility, including the ability to control substrate tension that allows for optimization of treatment efficiency, control over nitrogen removal, filamentous organisms, and overall stability. Other advantages include few operation and maintenance problems, smaller footprints than other types of plant, capability of being manned part-time from a remote location, no production of bulk sludge, and the system allowance for automatic and positive control of mixed liquor suspended solids concentration and solids retention time through sludge wasting. Disadvantages include difficulty in adjusting cycle times for smaller communities, possible requirement for postequalization if more treatment is needed, need for frequent disposal, and high energy consumption (EPA 2000).

3.2.2 Oxidation Ditches

An oxidation ditch is typically a channel configuration within a circular, oval, or horseshoe-shaped basin. Inside the ditch the wastewater is aerated with surface or submersible aerators. Aerators must provide sufficient oxygen and mixing to ensure contact between organisms and their food supply. Oxidation ditches are used for flow rates between 0.01 and 0.5 MGD. This type of plant handles typical domestic waste well, uses a moderate amount of energy, has inexpensive operation and maintenance costs, has low operational needs, can operate flexibly operating with or without a clarifier, consistently provides high quality effluent (TSS, BOD, ammonia), and has a low sludge yield. However, these plants can be noisy and can produce odors when not operating properly, are unable to treat highly toxic wastes, require a large footprint, and exhibit limited flexibility responding to changing effluent regulations. Nitrogen removal can be performed within the ditch by constructing a separate anoxic zone, but doing so reduces treatment capacity. It is best to perform nitrogen removal through a separate reactor (EPA 2000).

3.2.3 Extended Aeration Plants

The extended aeration process is a biological treatment for the removal of biodegradable organic waste. Oxygen is required to sustain the aerobic biological process; this can be achieved through mechanical or diffused aeration, which will also provide the mixing action to keep microbial organisms in contact with dissolved organics. For this process to be continually effective, essential nutrients must be available to promote biological growth and the pH must be controlled. These plants are typically used for flow rates 0.1 below MGD. They are easy to operate, easy to install, odor free, have a low sludge yield, and are often better at handling organic loading and flow fluctuations. Extended aeration plants do not perform denitrification or phosphorus removal without additional processes, have limited flexibility to adapt to changing effluent requirements, require more energy, and require a large footprint (EPA 2000).

3.2.4 Complete Mix

The Complete mix activated sludge process is an application in a continuous-flow stirred-tank reactor. The aeration tank has several points where settled wastewater and recycled activated sludge are introduced. The assumption in the process is that the mixed liquor suspended solids concentration and oxygen demand are uniform throughout the entire tank. This type of process dilutes shock loads that may come into the system from industrial wastes. The complete mix system is simple to operate. The system disadvantage is that there are low organic substrate concentrations encourage growth of filamentous bacteria, causing sludge bulking problems. A separate reactor would be needed to provide nitrogen reduction (Metcalf & Eddy 2003).

As indicated in Section 4, meeting Class A+ reclaimed water quality standards may not be sufficient for this plant. If the injected reclaimed water mixes with the subflow of the Verde River, ADEQ will likely require the Applicant to ensure the surface water quality standards for the respective reach of the Verde River are not exceeded by this practice. There is insufficient evidence or technical information about the hydrogeology and geochemistry of the area to ascertain whether water meeting Class A+ reclaimed water standards would be sufficient to also meet surface water quality standards at the point where injected water would adversely affect the Verde River water quality.

3.3 Regional Planning

Regional planning is the purpose of the MAG 208 process. The MAG 208 Small Plant approval process is specifically designed to eliminate a proliferation of small treatment plants. The Goldfield WRF is planned to serve parcels A and B of the Goldfield subdivision, including a small commercial area. There is intent to develop parcels C and D on the southeast side of Highway 87, which would be servce by septic systems. A nearby developer has also submitted to Maricopa County a notification of intent to develop a subdivision (known as "Grayhawk") of one to two units per acre, necessitating a sewer system (Grayhawk Development, 2007). There are also many developed lots in the area currently using septic systems.

To best use the MAG 208 planning process, the following issues should be reconsidered: the feasibility of accommodating the entire Goldfield area, the private lots, and the Grayhawk development. This is particularly important given that The Preserve at Goldfield Ranch is completely enveloped by the Tonto National Forest on three sides, and the FMYN on the west side. The proposed plant represents the best opportunity for maintaining and protecting water quality in the entire area.

From a consumer demand standpoint, it will be attractive for commercial development to occur along Highway 87, because this is the last remaining substantial stretch of land that could be used for commercial services before entering National Forest land, or on re-entry to the urban core. Consumer demand for commercial services may significantly influence land use associated with parcels C and D, and, therefore, the character and flow of wastewater to the proposed treatment plant. While the intention of the Applicant is that parcels C and D will be developed for single-family home sites, consumer demand can be accommodated through pursuit and acquisition of Special Use Permits from Maricopa County that would allow for a change of zoning to a commercial category. This process would need to be pursued outside of the MAG 208 review process.

3.4 Small Plant Operator and Plant Failures

The *Water Quality Management Plan* for The Preserve at Goldfield Ranch indicates that the wastewater treatment facility will be a 0.40-MGD reclamation facility to treat to Class A+ reclaimed water standards for groundwater recharge and reuse. Class A+ reclaimed water quality is appropriate for reuse, but does not guarantee compliance with aquifer water quality standards when injected into the ground. Once constructed by the Applicant, the reclamation facility will be owned and maintained by the Goldfield Preserve Water Improvement District, a County Improvement District (CID). The plant and sewage collection system are to be operated by A Quality Water Co. based in Williams, Arizona, nearly 3 hours from the Applicant's site.

A Quality Water Company operates small water and wastewater utilities in northern Arizona. The company does not have experience operating Aquifer Storage and Recovery wells. Their operators are certified and licensed in Arizona for Grades 2, 3 and 4 (CMX 2008). There are four grades of classification (1–4) for wastewater treatment plants, collection systems, and effluent distribution systems. The systems are classified according to the type, treatment process, and population served. The proposed 0.40-MGD treatment system at Goldfield Preserve will serve 3,283 people and include tertiary treatment, which, according to Maricopa County standards (MCEHC, 2007), classifies the system as Grade 3.

Because of the classification of the wastewater treatment facility, an on-site operator certified at Grade 2 or higher is required. If overseen by a remote operator, a Grade 3 or higher is required. If the site is overseen by a remote operator, the Grade 3 certified operator is required to reside within 3 hours travel time and must inspect the facility daily. The wastewater collection and reclaimed water distribution systems are classified based on the service area population, and will be operated by a Grade 2 or higher certified operator (MCEHC 2007). Because of these restrictions, the owner should identify an operator who resides closer to the development.

A Corporate Status Inquiry of A Quality Water Company LLC, indicates that the operator is in good standing with the Arizona Corporation Commission (ACC May 8, 2008). A search of the EPA's Safe Drinking Water Information System revealed minor monitoring violations for Grand Canyon Inn, Anazasi Water Co., and American Ranch DWID, which were listed as operated by A Quality Water Co. No health based violations were identified (SDWIS May 9, 2008). Monitoring and reporting violations are not uncommon with any system and do not represent a significant negative bias toward any operator.

3.5 Injection Wells

The storage of reclaimed water in the aquifer is currently practiced by municipalities in the Phoenix and Tucson areas. For large volumes, recharge is accomplished by water-spreading at direct surface recharge facilities such as the GRUSP and NAUSP projects in Phoenix and the Sweetwater facility in Tucson. The use of injection wells for reclaimed water recharge is more limited, however, because of the high cost of construction for small recharge volume, high maintenance costs, additional monitoring, and contingency requirements as well as water quality restrictions (HSI 2008).

In some cases, however, well injection is the preferred alternative when there is limited available land and geologic conditions are appropriate. Underground storage and recovery of reclaimed water is used by several municipalities in the Phoenix area.

> The Fountain Hills Sanitation District Underground Storage Facility consists of four Aquifer Storage Recovery (ASR) wells which inject reclaimed water in the Confined Regional Aquifer. Each well is designed for an injection and recovery rate of 400 gpm. The recharge and recovery operations are fully automated. The approximate cost of each well, fully equipped and instrumented, is approximately $1 million. The facility also includes five monitor wells for monitoring of water quality and hydraulic impacts (HSI, 2008, p. 10).

Over time, the recharge-specific capacity of the well diminishes because of the clogging from particulates, biological growth, and geochemical reactions. The wells require rehabilitation every 3–5 years, costing nearly $100,000 per well.

3.6 Plant Expansion

While it is understood that the existing plans provided by the Applicant do not need to be of sufficient detail to make a determination of expandability, the land area shown on Figure 5 of the Applicant's submittal appears to be large enough to accommodate a facility with a greater footprint. The existing conceptualized layout does not lend itself well to expansion, so a reconfiguring of the process facilities would be desirable for cost-effective expansion. The conceptual site plan shows disinfection using ultraviolet light following clarification, but before filtration. HDR recommends that disinfection occur following filtration. There are other technologies, such as membrane bioreactors, that would allow for substantial increases in capacity on the same plant footprint. It appears there is sufficient land area to accommodate treatment of wastewater flows from the areas of The Preserve and Goldfield Ranch that are not currently planned to be served by the plant.

3.7 Precedence for Small Plants in Similar Settings

There have been prior Small Plants approved both inside and outside of MPAs in Maricopa County; however, the proposed Goldfield Small Plant is unique in several ways.

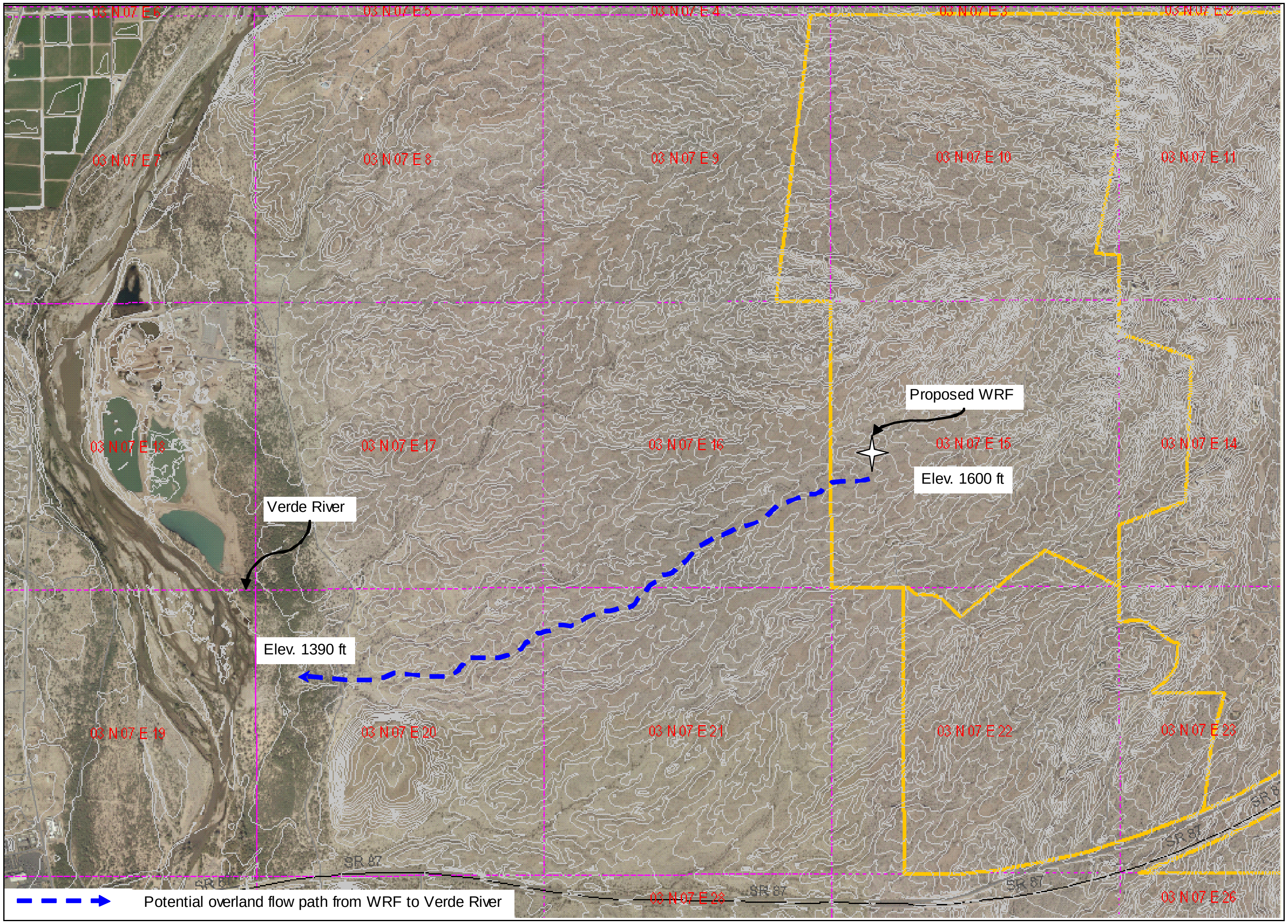
First, it is planned in an area for which known existing and additional development will occur and for which associated wastewater flows are not intended to be treated at the proposed plant. At a minimum, wastewater flows from the planned Grayhawk development and the other private lots within The Preserve and Goldfield Ranch should be considered for treatment by the proposed plant. Failing to account for additional development with this plant will lead to additional Small Plants or more septic systems. This is not consistent with the goals of the MAG 208 process.

Second, it will receive wastewater from residential and commercial properties, likely including restaurants, hotels, and other service industries. Further study and land use planning regarding commercial facilities should be conducted to understand the extent to which associated wastewater flows may influence the selected treatment technology and subsequent operations of the plant.

Third, it is located in an area of highly variable land relief near a high-value perennial stream. Plant or conveyance facility failures have a greater potential for rapid flow of raw sewage by gravity to a valuable water body: the Verde River. Overland flow routing calculations estimate that an unimpeded plant failure at full capacity (0.40 MGD) could result in raw sewage reaching the Verde River riverbed within 6 to 18 hours. Additionally, planned discharge of unusable treated wastewater is to the aquifer below the facility, which is near the Verde River (within 2.5 miles). Based on review of hydrogeologic information, direct connection of the aquifer to the subflow of the Verde River is not conclusive. Therefore, future review of the reclamation facility plans by ADEQ may necessitate the inclusion of surface water quality standards in an APP.

Fourth, it is enveloped by sensitive habitat, a Native American community, and the Tonto National Forest, and will likely never be included in an MPA within the county. In comparison to the Small Plants identified in Section 3, the responsibility for this plant will initially and likely always be a CID. Based on the factors identified above, the plant and associated sewage collection facilities may require sophisticated technology, operation, and attentive control, and should be sized to manage the wastewater from the entire area of private and developable land. Additionally, operation, maintenance, and replacement costs will be significantly higher per service connection than the typical wastewater system, which may be difficult for a CID to continuously fund.

Figure 1: Potential overland flow path from WRF to Verde River



4.0 Identification of Additional Concerns

In the process of its review, HDR identified additional issues that may be of concern to SRP-MIC. This section describes these issues.

4.1 Discharge to Subflow of the Verde River

Arizona Administrative Code (AAC) R18-11-405 B states, “A discharge shall not cause or contribute to a violation of a water quality standard established for a navigable water of the state.” Surface water quality standards are typically much more stringent than those for groundwater, which means that additional treatment technology beyond that currently proposed by the Applicant may be required for reliance on injection and recovery for management of the reclaimed water.

There is uncertainty regarding whether there is a confining layer that prevents or slows movement of groundwater from underneath Goldfield Ranch to the Verde River. If it is determined through additional hydrogeologic studies that the injection of Class A+ reclaimed water from the Applicant’s proposed water reclamation facility would join and mix with the subflow of the Verde River, ADEQ may consider the injection of the water into the subflow as a point source “discharge” and require an AZPDES permit, or for ADEQ to require that Surface Water Quality Standards for the respective reach of the Verde River be met as part of the APP. In either case, the reclaimed water would need to meet the discharge water quality criteria for the respective reach of the Verde River.

The surface water quality standards specific to the Verde River between Bartlett Dam and the Salt/Verde confluence are listed in the AAC R18-11-123. The designated uses of this reach of the river are wildlife (aquatic and wildlife warm water), agricultural (irrigation and livestock watering) and human (full body contact, fish consumption and domestic water supply). Because of the potential impact to human health, increasingly stringent water quality compliance is required. Any wastewater discharges adversely affecting the river must meet all of the water quality criteria or demonstrate that the river blended with the discharge would not exceed the criteria for any designated use. Appendix B is a listing of the water quality criteria by designated use.

From a water quantity and accounting standpoint, it may be difficult for the applicant to demonstrate that pumped groundwater (as is depicted in Figure 5 of the Applicant's request) can be accounted for as reclaimed water if the injected water moves quickly toward the river and flows out of the area of hydrogeologic impact.

4.2 Remote Facilities in Proximity to Sensitive Habitat and Verde River

Based on a review of the topography of The Preserve at Goldfield Ranch and of the supporting information provided by the Applicant, a number of sewage lift stations will be required to convey collected wastewater to the treatment plant. While it is intended that redundant power will be provided at the water reclamation facility, there is no mention of redundant power supply to the lift stations, which will serve as intermediate collection points of sewage throughout the planned community. Pump failures in these locations would result in raw sewage overflows into the community and washes that lead to the Verde River. It is possible to construct wastewater storage facilities to enable longer response times to pump failures, but odor and corrosion control would become a significant maintenance issue.

5.0 Evaluation of Concerns

It is HDR's assessment that wastewater collection and treatment for the entire area (The Preserve and Goldfield Ranch) are in the best interest of Maricopa County and all users and beneficiaries of the Verde River. The proposed plant should not be considered similar to other approved Small Plants serving relatively flat areas away from perennial streams. The potential for surface water impairment with raw sewage is much higher than with other plants because of the steep topography and proximity of the plant to the Verde River. HDR believes the proposed plan for on-site treatment (septic systems) for parcels C and D is not in the best interest of the protection of regional water quality. Available hydrogeologic information is inconclusive regarding an impeding layer that would prevent injected reclaimed water from reaching the subflow of the Verde River. If the injected reclaimed water reached the subflow of the Verde River, it would need to meet surface water quality standards for the respective reach of the river. Finally, the proposed collection system, treatment plant, reclaimed water distribution system, and management of unusable reclaimed water by injection will be expensive to operate, maintain, repair, and replace for a CID that will rely heavily on approximately 1,000 single-family home sites.

The MAG 208 *Water Quality Management Plan* is the County's first defense against degradation of water quality. It is entirely appropriate and expected that MAG would apply increased scrutiny to a proposed plant that will be owned and operated by a CID, is very close to a valuable perennial stream, and for which there is limited ability to cost-effectively mitigate service failures to prevent raw sewage from entering the river. At a minimum, according to the intent of the MAG 208 planning process, the plant should be planned and sized to treat sewage from the entire area, and further assessment regarding the categorization of the plant (based on the potential for Verde River water quality impacts) should be made before MAG approves the plant for amendment into the *Water Quality Management Plan*. Regional wastewater collection and treatment best protect water quality, and more consideration needs to be given to the risks posed by the location of the proposed plant and the nature of the wastewater flow and quality characteristics it may be processing on startup or in the future.

6.0 Conclusions

While the Applicant has successfully addressed some of the issues pertinent to the MAG 208 process, there are key components in the application that have not been adequately addressed by the Applicant. Consequently, the application is inconsistent with the MAG 208 *Water Quality Management Plan*. HDR identified these inadequacies:

- Plant location and local features
- Service area
- On-site treatment
- Potential surface water quality impacts from injection
- Owner/operator financial capability

6.1 Plant Location and Local Features

The unique features of the proposed plant's location relative to the Verde River, the surrounding topography, and the increased risk it poses to surface water quality standards that have been established for the protection of wildlife and humans have not been adequately considered. While the proposed plant would have redundant power supply and on-site retention, a service failure of it or of the associated sewage lift stations throughout the community (which are not proposed to have redundant power or retention) would result in a sewage overflow that could make its way to the Verde River. The proposed plant location is 2.5 miles from and 210 feet above the Verde River. At build out capacity, unimpeded wastewater overflows from the proposed plant could reach the river within 6 to 18 hours of plant failure.

6.2 Service Area

The intent of the MAG 208 review process, as set forth by Section 208 of the CWA, is to protect water quality through a regional planning process. The MAG 208 process has also incorporated Growing Smarter Legislation principles to strengthen the regional planning role of MAG for multiple benefits to current and future generations of inhabitants. The *Water Quality Management Plan* and related amendment process for Small Plants is intended to prevent the "uncontrolled proliferation of Small Plants that could cause problems in the future." The proposed plant will serve a limited land area within a larger and completely enveloped county island that contains existing development with septic systems and plans for additional development (including Grayhawk) that will require or could benefit from sewer collection and treatment. Not providing sewer service to the entire area would encourage the proliferation of Small Plants and septic systems in the area and, in turn, increase the risk to regional water quality.

6.3 On-Site Treatment

The proposed plant would receive wastewater from residential and commercial properties. The Applicant has indicated that at least one commercial facility, a resort/spa, may be included. Land along State Route 87 will be highly desirable for commercial facilities, because they are the last opportunity along the highway for such facilities for travelers leaving the urban core and the first opportunity for those entering the urban core, along the highway. The Applicant currently proposes that parcels C and D, which would be the most desirable for commercial facilities, would be served by septic systems (on-site treatment). The Applicant states an intention to develop parcels C and D with single-family home sites greater than an acre. However, Special Use Permits can be obtained from Maricopa County to respond to consumer demand, to effectively change the zoning and land use from residential to commercial. Such changes are not subject to review by the MAG 208 process. Regardless of what type of development occurs along State Route 87 on parcels C and D, use of septic systems as the on-site wastewater treatment technology is not a sound plan for protection of regional water quality. However, inclusion of significant commercial wastewater flows into the proposed plant would likely cause wide fluctuations in influent wastewater quality that may challenge the treatment capabilities of the proposed biologically active plant.

6.4 Potential Surface Water Quality Impacts from Injection

The proposed water reclamation facility at The Preserve at Goldfield Ranch initially appears to meet the criteria for a Small Plant (less than 2.0 MGD and not requiring a CWA discharge permit) that is outside of an MPA but within 3 miles of cities or towns that have Small Plant Planning Areas. In Arizona, the CWA discharge permit is called an AZPDES permit, and is used to maintain and avoid degradation of surface water quality.

Management of the unusable portion of the proposed plant's reclaimed water through injection wells would require compliance with surface water quality standards if it is demonstrated that the injected water mixes with the subflow of the Verde River. That is, production of Class A+ reclaimed water would not be sufficient, if this were the case. Review of hydrogeologic data from the Arizona Department of Water Resources (ADWR) and SRP indicates that the existence of a continuous clay layer that would prevent or retard injected Class A+ reclaimed water from entering the Verde River is inconclusive. Further, the analysis of the 72-hour aquifer test conducted in 1985 at The Preserve at Goldfield Ranch reveals a response more typical of a leaky confined aquifer or proximity of a recharge boundary, not of a confined aquifer. In this circumstance, ADEQ will likely require compliance with surface water quality criteria for the reach of the Verde River into which the discharge would be received. At ADEQ's discretion, these criteria could become part of the Applicant's APP, or could be implemented through a separate AZPDES permit. In either case, the potential exists for surface water quality standards (derived from the CWA) to be included in a permit. Therefore, a determination needs to be made at this point in the planning process regarding what type of plant the Goldfield Water Reclamation Facility is before an application for amendment to the MAG 208 *Water Quality Management Plan* can be made.

6.5 Owner/Operator Financial Capability

While the Applicant has demonstrated financial capability to build the plant, the operation, maintenance, and repair and replacement of infrastructure and appurtenances for the collection system, plant, and the distribution (reuse) and management (injection and recovery) system of reclaimed water would be relatively expensive for a CID made up largely of residential customers (approximately 1,000 service connections) to continuously fund. For example, if an aquifer storage and recovery well (as is implied by Applicant's Figure 5) were to fail and need to be replaced, it would cost the CID approximately $1 million to replace it. Based on historical performance of injection wells in the Maricopa County area, injection wells need to be rehabilitated every 3–5 years at an average cost of $100,000. Also, the increased risk to surface water quality translates to an increased risk of violation and fines imposed on the CID. The Applicant has stated that the developer will supplement the financial security of the CID, but does not indicate for how long. Regardless, this issue does not appear to be adequately addressed by the Applicant, and there appears to be the potential for a significant financial burden to the future CID.

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Appendix A – Hydrologic Data Evaluation

The Preserve at Goldfield Ranch

Maricopa County

Hydrologic Data Evaluation

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08-538
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ILLUSTRATIONS

TABLES

Background

The Preserve at Goldfield Ranch is planning to construct a water reclamation plant on their Parcel A, located on Township 3 North, Range 7 East of the Gila and Salt River Base and Meridian (Figure 1). The estimated capacity of the water reclamation facility (WRF) is 0.4 million gallons per day (MGD). The WRF will treat the effluent to A 1+ reclaimed water standard and will be stored underground using well injection. Three recharge wells will be used and will be spaced approximately one mile apart. One monitor well will be placed down gradient of the recharge wells.

The Preserve at Goldfield Ranch is going through a permitting process for the approval of its WRF under the MAG 208 Plan. The Salt River Pima Maricopa Indian Community (SRPMIC) has expressed concerns of potential impacts to groundwater resulting from the operation of the WRF, and the disposal of the reclaimed water to the underlying aquifer. Some of these concerns presented by the Preserve at Goldfield Ranch on their March 20, 2008 presentation to the MAG committee are:

- Groundwater level decline will affect the community's water resources
- Storm water and irrigation water may percolate into upper/middle aquifer and impact the Verde River.
- Clay layer does not confine upper and lower aquifer and thins out at the edges
- Is the Fountain Hills (Lower Verde River Valley) groundwater basin in hydraulic connection with the adjacent basins? (For example the East Salt River Basin).

Both groundwater quantity and quality issues are related to each of the four potential impacts listed above. The brief hydrogeologic analysis that follows will provide the essential elements to address these issues. More detailed information can be obtained from the references cited.

Geologic Summary

The area of the planned Preserve at Goldfield Ranch is located on the west side of the Lower Verde River Valley groundwater Basin (LVRVGB). Its surface expression is a valley that is elongate in a northwest – southeast direction with a length of approximately twenty eight miles. Its maximum width in a northeast – southwest direction is twelve miles. The northwest – southeast orientation of this basin is the predominant alignment of the young Cenozoic age sedimentary basins of the Basin and Range physiographic province of Arizona and in general reflects the geologic history of this region (Damon, et al., 1984 and Dickinson, 1989).

The surrounding highlands that bound the Lower Verde River Valley groundwater basin are the Mazatzal Mountains to the east and north, the McDowell Mountains to the west and the Goldfield Mountains to the south. The principal drainages of this basin are the Verde River and its two main tributaries in this area which are Camp Creek and Sycamore Creek. The Verde River flows to the south traversing the basin along most of its central area. The Salt River flows to the west along the southern edge of the basin, and receives the water of the Verde River where the McDowell Mountains contact the Goldfield Mountains just upstream from Granite Reef Dam.

The LVRVGB contains an alluvial aquifer system contained in sedimentary rock units deposited in the relatively recent geologic past. These sediments correspond to the Gila Assemblage (Scarborough, 1989), which is the youngest of the four "stratotectonic assemblages" of southern Arizona. It corresponds to Unit II of Eberly and Stanley (1978), and is the sedimentotogical response to the most recent tectonic event affecting southern Arizona—the Basin and Range disturbance. These sediments are basin-fill units that have characteristics suggesting deposition totally within the confines of the present-day physiographic basins. Skotnicki and others (2003) identified four basin-fill units of Late Tertiary age in the LVRVGB. From oldest to youngest they are: (1) the Needle Rock Formation, (2) the Pemberton Ranch Formation, (3) younger basin-fill sedimentary deposits, and (4) Quaternary surficial deposits.

The Needle Rock Formation (sandstone and conglomerate) forms the lower aquifer. It is overlain by and partially grades laterally into the Pemberlon Ranch Formation, which is composed mostly of interbedded siltstone, claystone, fine-grained sandstone, and minor coarser-grained sandstone and conglomerate. These predominantly fine-grained deposits behave as an aquiclude separating the lower and upper units of the LVRVGB aquifer system throughout a large part of the basin. Two units overlie the

Pemberton Ranch Formation. The lowermost is composed predominantly of sandstone and conglomerate and forms the younger basin-fill deposits of Late Tertiary age. Resting on these units, mostly in erosional unconformity, are relatively thin river and piedmont deposits of Pleistocene-Holocene age. The younger basin-fill unit, and in places the river and piedmont deposits, compose the upper aquifer of this basin. The sedimentary sequence observed in the LVRVGB is common in several other young alluvial basins of southern Arizona, indicating similar erosional and depositional history related to common structural events.

In the East Salt River Valley basin to the south the three commonly reported units of the aquifer system are: Lower Alluvial Unit, Middle Alluvial Unit, and Upper Alluvial Unit. They are comparable to the Needle Rock Formation, the Pemberton Ranch Formation and the younger basin-fill respectively. Some wells in Scottsdale penetrate a red-colored unit composed of sandstone and conglomerate (the 'Camel's Head Formation') which is older than and underlies the Lower Alluvial Unit. This 'red unit' is well exposed in the southern margin of the valley on the south side of Fountain Hills (Skotnicki, 1995). Near Camelback Mountain the red unit is a fractured bedrock aquifer and a limited volume of groundwater is pumped from this unit by Salt River Project wells.

The formation of the LVRVGB is the result of regional crustal extension which occurred mostly between 35 Ma to 8 (+/-) Ma (Ma = millions of years ago) in the western USA (Rehrig, 1986). Two separate tectonic events have been identified. The early one, recognized as the Mid-Tertiary orogeny (Oligocene to Middle Miocene) was more intense and of longer duration. The later event is the Basin and Range disturbance (post 15 Ma). Many of the present-day basins in southern Arizona started forming during the Mid-Tertiary orogeny. The red unit was probably deposited during this episode and most of the consistent, unidirectional tilting of this unit is characteristic of this event. Spencer and Reynolds (1986) divide the Basin and Range region of Arizona into regional tilt-block domains in which rocks of middle Tertiary age dip predominantly in one direction. They interpret dip direction in each tilt-block domain is toward the breakaway of the detachment fault that underlies the block. This indicates that the normal (listric) faults in the upper plate of the detachment fault dip in the same direction than that of the master fault.

The Phoenix area including the LVRVGB is within the "Camelback Domain" where rocks of middle Tertiary age dip to the southwest. This bedding attitude is observed in the red beds that crop out at Mount McDowell in the southern part of the LVRVGB (Skotnicki, 1995). Menges and Pearthree (1989) reported that northwest-trending basin orientation in southern Arizona predominantly reflect southwest-northeast extension associated with middle Tertiary deformation. Many of these basins were overprinted by the subsequent formation of Late Miocene basins formed during the Basin and Range disturbance (Nations et al., 1985; Keith et al., 1985; Menges, 1983; and Scarborough, et al., 1983).

Early reconnaissance geologic mapping identified the LVRVGB as a basin separated from the Salt River basin to the west (Wilson et.al, 1957). The enclosing mountains are composed of sedimentary volcanic and metamorphic rocks of Precambrian (Early Proterozoic) age intruded by granites of Early and Middle Proterozoic age. Resting on these rocks, and commonly in fault contact with them, are sedimentary and volcanic rocks of Middle Tertiary age (red beds and predominantly felsic- to mafic-composition volcanic rocks). The surface distribution of all the rock units - Precambrian, Middle Tertiary and Late Tertiary age exposed in the LVRVGB and surrounding area indicates an "L" shape for the physiography of this basin (Richard et al., 200). This is likely the influence of the confluence of Salt and Verde Rivers in the southern part of the basin, and the resulting erosion and sedimentation related to both drainages. Both the residual aeromagnetic map of Arizona (Sauck and Sumner, 1970) and the residual Bouguer gravity anomaly maps of Arizona (Lysonski et al., 1981) show the axis of the LVRVGB striking in a north-northwest direction. Skotnicki and others (2003) reported that this configuration is consistent with the deepest portion of the basin adjacent to and parallel to the gravity-low axis. The gravity-low exists where it does, towards the west side of the basin, probably as a result of faulting along Camp Creek fault and the subsequent formation of a half graben, with its down-dropped side on the east-northeast (Figure 2). This type of structure is common in basins formed during both the Mid-

Tertiary orogeny and the Basin and Range disturbance. Modeling of the gravity data indicates a maximum depth to bedrock in the LVRVGB of 4800 – 6400 feet (Oppenheimer and Sumner, 1980).

The more pertinent and complete geologic information of the LVRVGB is contained in Skotnicki (1995), and Skotnicki and others (2003).

Groundwater Hydrology

Hydrostratigraphy

Three stratigraphic units constitute the components of the aquifer system of the LVRVGB. From older to younger they are: The Needle Rock Formation (map unit Tsn), the Pemberton Ranch Formation (map unit Tsp), and the younger basin-fill deposits (map unit Tsy and Tsm), (Skotnicki et al., 2003), (Table 1). Thomsen and Schumann (1968) called these units 'consolidated alluvium'. The youngest Pleistocene-Holocene deposits were mapped by Skotnicki (1995) and grouped into four major groups of which the Piedmont Deposits and the River Deposits may in places be water bearing . They are predominantly unconsolidated silt, sand and gravel, and in places convey the underflow of the Verde River and its tributaries. The younger basin-fill (consolidated alluvium of Thomsen and Schumann, 1968) has low permeability measured in shallow wells in Sycamore Creek with results that ranged from 2-12 g/d-ft^2 as compared to the unconsolidated alluvium value of 5,200 g/d-ft^2.

The aquifer above the Pemberton Ranch Formation is termed the Alluvial Floodplain Aquifer (HSI, 2003). The Pemberton Ranch Formation is composed predominantly of siltstone, claystone and fine-grained sandstone and also contains minor coarse-grained sandstone and conglomerate. It is considered an aquiclude/aquitard, confining groundwater in the predominantly subjacent Needle Rock Formation (Figure 3). Deposited during a period of slow subsidence of the LVRVGB it is, in general, similar in lithology and depositional origin to thick fine-grained, low permeability clastic deposits in other basins of southern Arizona (Holzer and Lluria, 1987). The areal extension and thickness of the Pamberton Ranch Formation is an important factor in determining the possible hydraulic connection of the Alluvial Floodplain Aquifer and the

Needle Rock Formation (regional aquifer). If the fine-grained unit is absent in the mountain front edges of the basin, as is the case in other southern Arizona basins, direct recharge to the regional aquifer from runoff can take place in these areas.

The regional aquifer termed here the Confined Regional Aquifer (HSI, 2003), is contained within conglomerate of the Needle Rock Formation. This unit, estimated to be as much as 1,000 feet thick (Deslauriers, 1977), appears to be fracture, providing adequate secondary porosity and permeability. The red unit may underlie the Needle Rock Formation, as it does in parts of the East Salt River Basin, and be part of the Regional Confined Aquifer in the LVRVGB.

Aquifer Characteristics of the Regional Aquifer

Pumping tests carried out in the Fountain Hills (HSI, 2003, and E.L. Montgomery and Associates, Inc, 2004), and in the Goldfield Heights area indicate that the Regional Aquifer is confined. In the Fountain Hills area transmissivity ranged from 23,000 to 71,000 gpd/ft (HSI, 2003) with a storativity from 0.0044 to 0.00014. These were from short duration pump tests. Two production wells of the Chaparral City Water Company were pump-tested for 72 hours and gave transmissivities of 190,000 gpd/ft, and 209,000 gpd/ft, respectively. The storativity for these wells ranged from 0.00015 to 0.00092 (E.L. Montgomery and Associates, Inc., 2004). In the Goldfield Heights area (Preserve at Goldfield Ranch) a 72 hour pumping test was carried out in 1985 by E.L. Montgomery and Associates, Inc. Transmissivity values obtained from one well and an observation well averaged 45,000 gpd-ft with a storativity of 0.0002 (Southwest Groundwater Consultants, Inc., 2006).

Analysis and Observations

This report is based on available geologic and hydrogeologic data from previous work in the Fountain Hills and the Goldfield Heights area. Analysis of information shows:

- The area of the Preserve at Goldfield Ranch is located in the western side of the LVRVGB, a structural basin formed probably mostly during the Basin and Range disturbance. Its axis strikes north-northwest, as indicated by gravity and aeromagnetic surveys. Most of the faults mapped in the highlands surrounding the basin also strike north-northwest with down dropped sides to the northeast. Movement on the Camp Creek fault may have formed a half graben which determined the structural morphology of the LVRVGB.

- An early period of high energy erosion and sedimentation in the LVRVGB deposited the Needle Rock Formation (predominantly conglomerate) which was fractured and constitutes the present day Confined Regional Aquifer. This period was followed by a period of sedimentation dominated by lacustrine (lake) deposits. Fine-grained deposits of the Pemberton Ranch Formation were deposited during this time. This unit, as in other Basin and Range basins of Arizona, has rapid facies changes in both horizontal and vertical directions. It may be interbedded with coarse alluvial fan deposits near the edge of the basin. Because of the predominance of clay and silt, resulting in low permeability, this unit is an aquiclude and imparts confinement to the regional aquifer where it overlies the Needle Rock Formation. After the regional integration of the Verde River drainage an active fluvial regimen deposited the younger basin-fill sediments which are partially covered with weakly consolidated alluvial deposits (or 'unconsolidated alluvium'). These younger deposits, and some of the more permeable portions of the basin-fill units overlying the Pemberton Ranch Formation, form the Floodplain Alluvial Aquifer.

- After examination of numerous drillers logs from The Preserve at Goldfield Ranch and adjacent areas, we can conclude that there is insufficient good-quality information to map the extent of the Pemberton Ranch Formation in the study area with the sufficient accuracy. Only three wells on Section 10 of T3N R6E provide quality data (Figure 4). These are wells GE-1, GE-2 and GE-3, drilled in 1985 and logged by E.L. Montgomery and Associates, Inc. These wells intersect 250 feet of silty clay at 400 feet depth. These three wells are located on the northwest corner of Parcel A of the Preserve at Goldfield Ranch (Southwest Groundwater Consultants, 2006).

- The only pumping test available from the Preserve at Goldfield Ranch reported transmissivity and storativity values comparable to some of the wells in Fountain Hills. This single 72-hour test however, shows much lower transmissivity than 72-hour tests carried out in two of the municipal water supply wells in Fountain Hills. The storativity for these three wells are of the same magnitude.

- Examination of the 72-hour aquifer test of the two municipal supply wells in Fountain Hills shows a typical Confined aquifer response. In contrast, the analysis of the 72-hour aquifer test of the Preserve at Goldfield Ranch shows a response more typical of a leaky confined aquifer or the proximity of a recharge boundary. These conditions require further investigation.

Recommendations

To better define and map the extent of the Pemberton Ranch Formation (clay layer/aquiclude), the following is recommended:

- Drill two test boreholes to a depth of 1,000 feet—one at the location of the proposed recharge wells, and one approximately equidistant between the recharge wells and test borehole A (3-7) 24 cbd (Figure 4). Detailed lithologic logging and borehole geophysical logging should be carried out at each test hole.

- Undertake a geoelectric (TEM, CSAMT, CR) survey to determine depth and extent of the clay layer from the Verde River to the east and south boundaries of The Preserve at Goldfield Ranch.

- Undertake a 7-day pump test at well G-3 to establish the nature of the confined aquifer (confined/semi confined) and determine possible recharge of the regional aquifer from the alluvial aquifer.

Other Questions From The SRPMIC

Will groundwater level decline affect the community's water resources?

For a proper evaluation of the potential effects of pumping in the Preserve at Goldfield Ranch, a groundwater model needs to be developed.

Storm water and irrigation water may percolate into upper/middle aquifer and impact the Verde River (water quality)?

The abundance of fine-grained sediments in the soil system below the Preserve at Goldfield Ranch should produce a soil aquifer treatment effect on any water percolating in the soil and eliminate/mitigate any water quality impacts. A pilot test should be carried out.

Is the Fountain Hills (LVRVGB) in hydraulic connection with the East Salt River Valley Basin?

No, it is not.

The Use of Injection Wells for Reclaimed Water Recharge in the Phoenix Area

The storage of reclaimed water in the aquifer is currently practiced by many municipalities in both the Phoenix and Tucson areas. The preferred method for large volume is by water-spreading at direct surface recharge facilities. The recovery is then carried out using existing wells. Examples are the GRUSP and NAUSP projects in Phoenix and the Sweetwater facility in Tucson. Vadose zone wells are also used by some municipalities. Scottsdale's Water Campus has been using this methodology successfully for several years. The use of injection wells for reclaimed water recharge is more limited. Some of the reasons for this are:

- Smaller recharge water volume
- High cost of well construction
- High maintenance cost
- Water quality restrictions
- More monitoring requirements
- More detailed contingency plans

In some cases however, well injection is the preferred alternative. When available land is limited because of its high cost or inability to purchase or lease for the construction of recharge basins, and geologic conditions do not favor the use of vadose zone recharge wells, only injection wells can be employed.

Underground storage and in some cases recovery of reclaimed water is used by several municipalities in the Phoenix area. The first project was the INTEL recharge project in Chandler, where treated industrial effluent is injected into the Middle Alluvial Unit. There is no recovery of the injected water in this facility. There are four other projects that use injection. These are Tumbleweed Park (Chandler), Arrowhead Ranch (Glendale), Fountain Hills Sanitation District, and Pima Utilities.

The Fountain Hills Sanitation District Underground Storage Facility consists of four ASR (Aquifer Storage Recovery) wells which store reclaimed water in the Confined Regional Aquifer. Each well is designed for an injection and recovery rate of 400 gpm. The recharge and recovery operations are fully automated. The approximate cost of each well, fully equipped and instrumented, is approximately one million dollars. The facility also includes five monitor wells for monitoring of water quality and hydraulic impacts. With time and use the recharge specific capacity (the measurement of the ability to recharge) of the well diminishes due to the clogging from particulates, biological growth, and geochemical reactions. The wells then need to be rehabilitated. In the case of the ASR wells of the Fountain Hills Sanitary District, the cost of well rehabilitation is approximately $100,000 per well (Small et al., 2007). The rehabilitation is required every three to five years.

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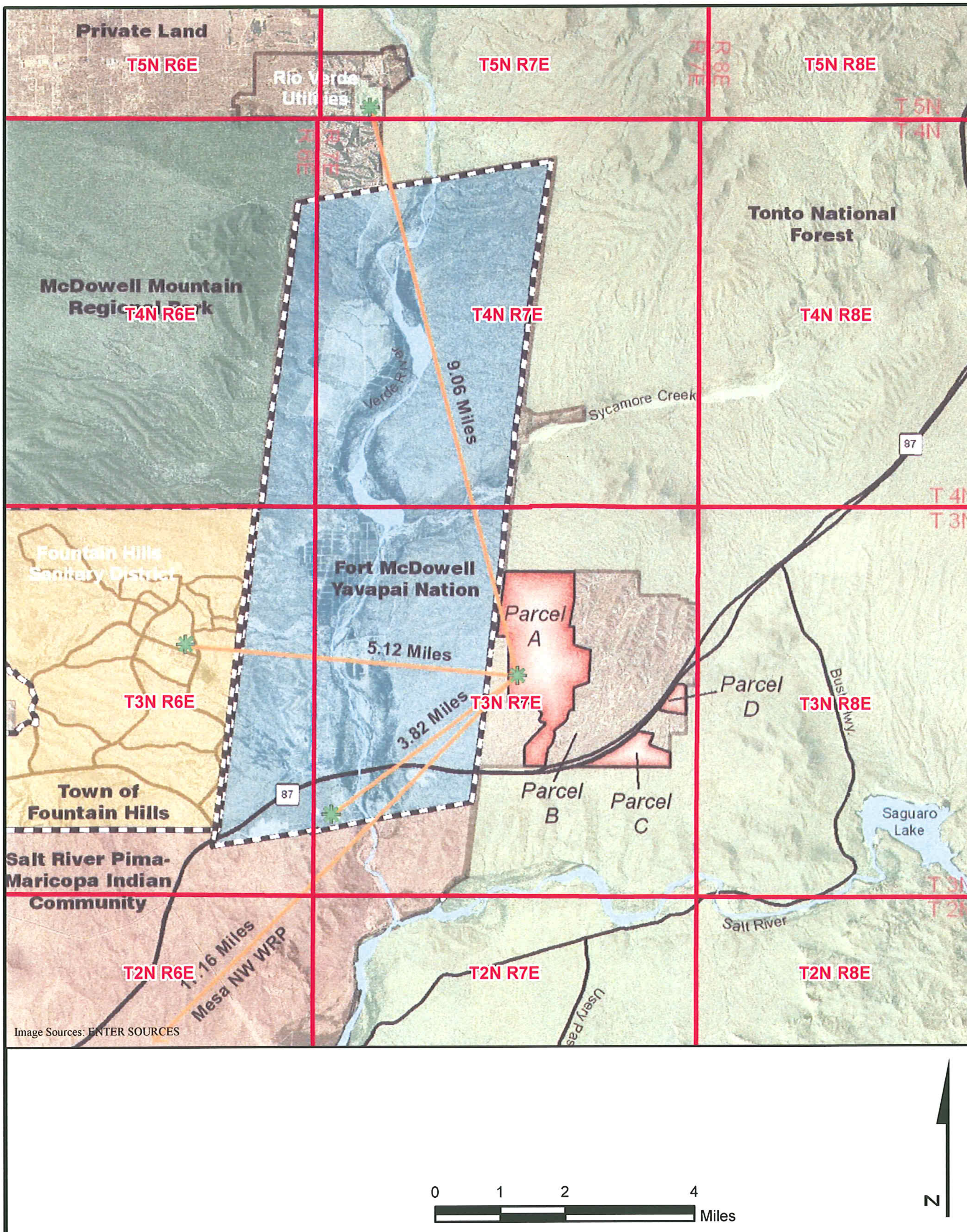

HSI HydroSystems Inc.

Location Map
The Preserve at Goldfield Ranch

Figure 1

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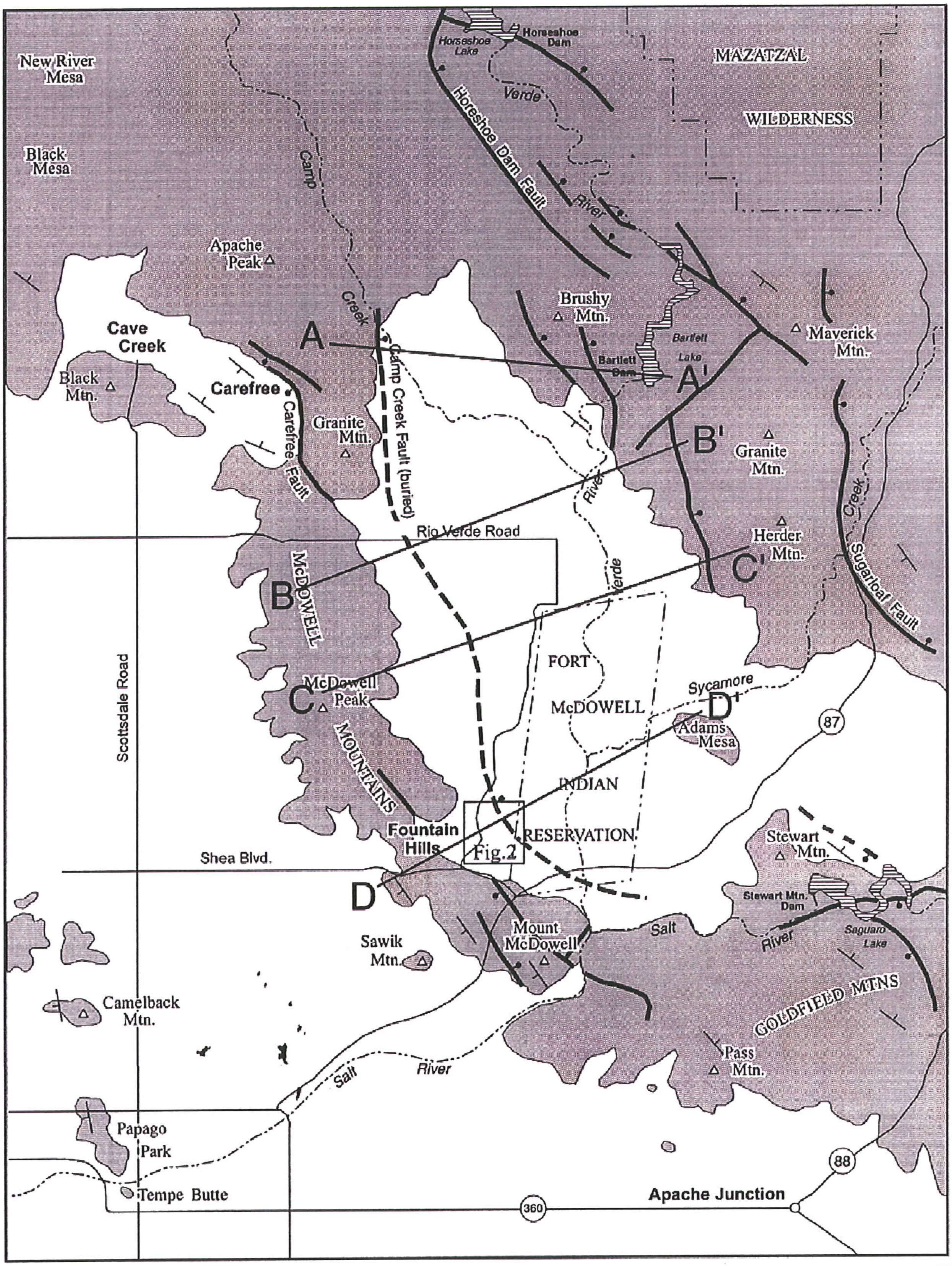

HydroSystems Inc.

Structural Map and Location of Cross-Sections of the Lower Verde River Valley Groundwater Basin

*Skotniki (2003)

Figure 2

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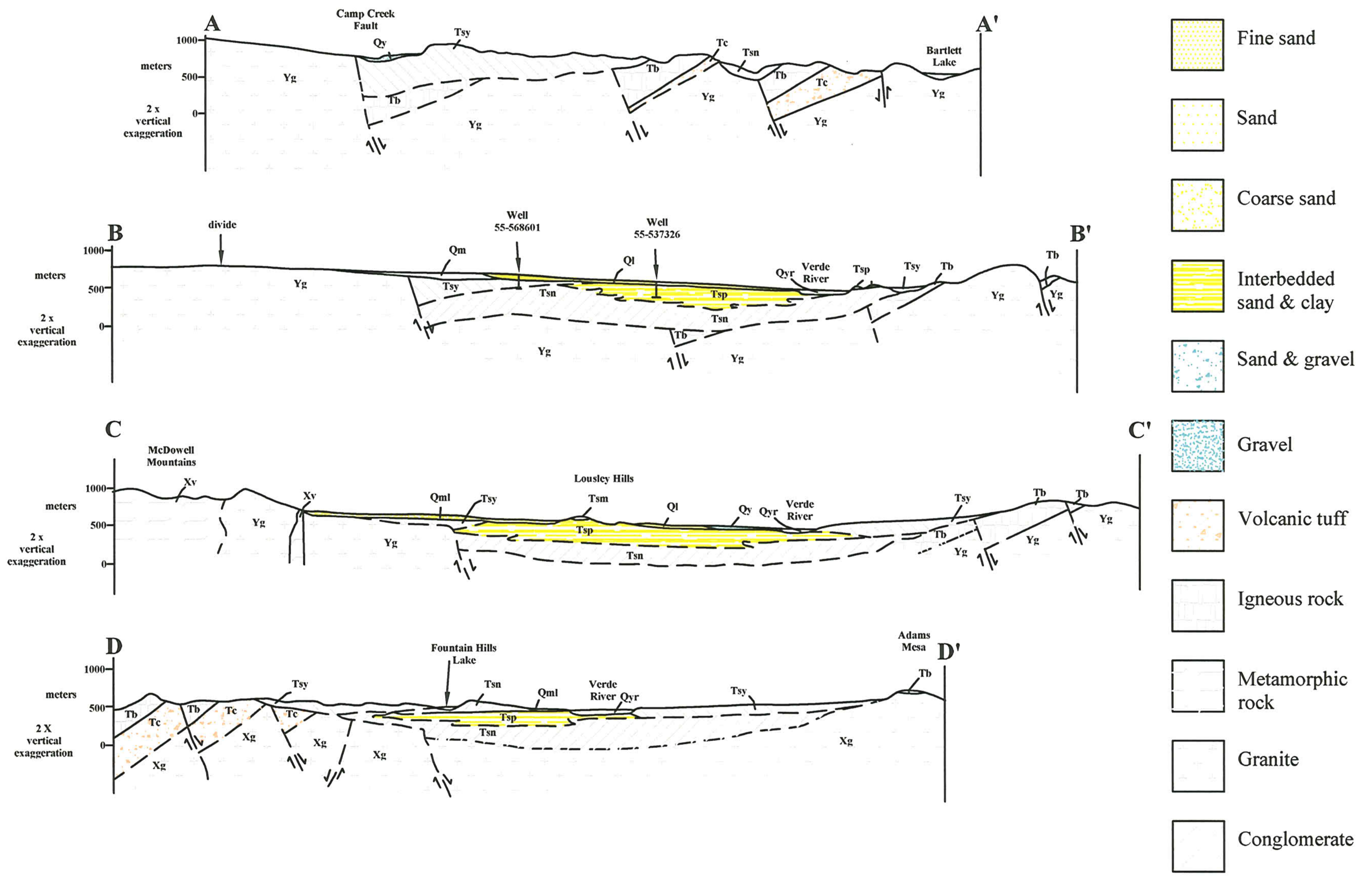

HydroSystems, Inc.

Geologic Cross-Section of the Lower Verde River Valley Groundwater Basin

*Skotnicki (2003)

Figure 3

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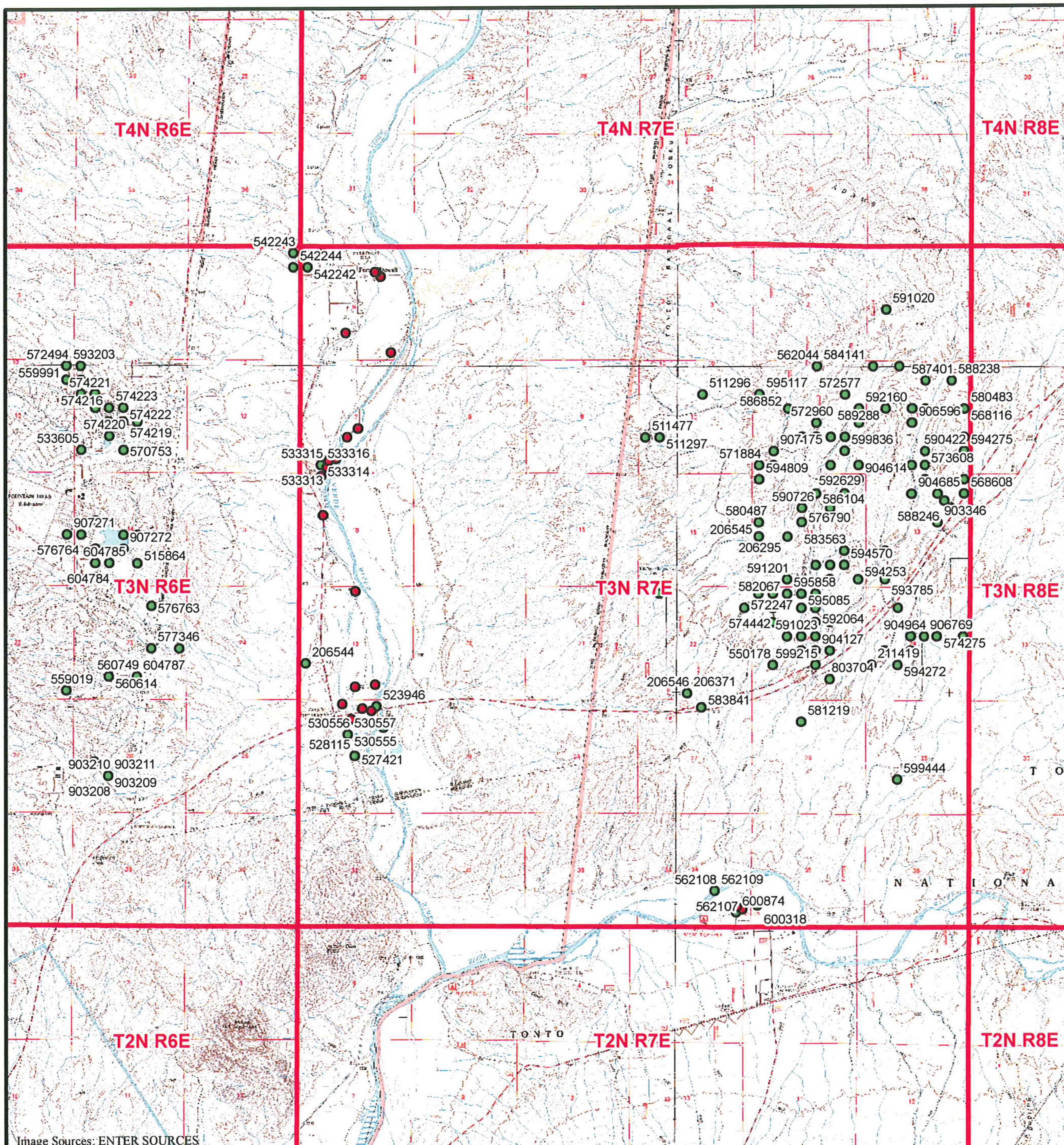


Legend

- GWSI Wells
- 55 Wells

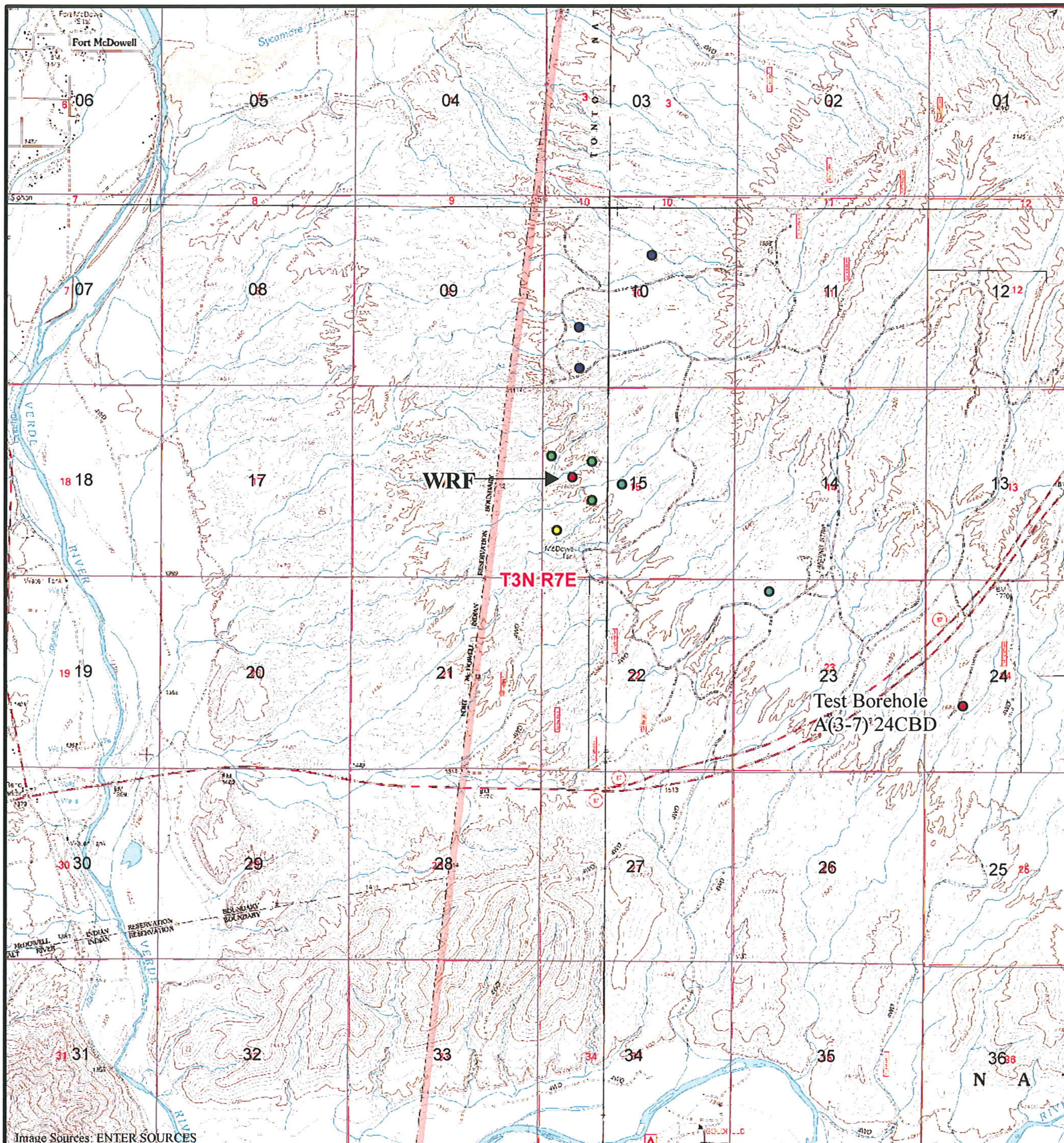
0 0.5 1 2 Miles

N

HSI HydroSystems Inc.

Fountain Hills and The Preserve At Goldfield Ranch Location of Wells

Figure 4



Legend

- Proposed Monitor Well
- Proposed Recharge Wells
- Recommended Test Wells
- Water Supply Wells

0 0.5 1 2 Miles

N

HSI HydroSystems Inc.

The Preserve at Goldfield Ranch
Recommended Test Wells

Figure 5

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Table 1

UNITS OF THE AQUIFER SYSTEM

Lower Verde River Valley Groundwater Basin

Unit	Formation	Age	Type	Predominant Lithology	Aquifer Type	Structural Association
Flood Plain Alluvial Aquifer	Alluvium	Holocene-Pleistocene	Alluvial/Fluviatile	Sand, gravel, silt	Unconfined	Youngest fluvial cycle
Clay Layer	Pemberton Ranch	Pleistocene-Pliocene	Lacustrine	Siltstone, claystone, minor sandstone	Aquiclude	Basin & Range: disturance basin subsidence
Confined Regional Aquifer	Needle Rock	Late Miocene	Fluviatile: high energy	Conglomerates, breccias, sandstone	Confined/Semi-Confined	Basin & Range disturbance: high angle faulting

Appendix B – Department of Environmental Quality – Water Quality Standards

BASIN	SEGMENT	LOCATION	A&Wc	A&Ww	A&We	A&Wedw	FBC	PBC	DWS	FC	AgI	AgL
VR	Meath Dam Tank	35°07'46"/112°27'35"		A&Ww			FBC			FC		AgL
VR	Mullican Place Tank	34°44'16"/111°36'08"		A&Ww			FBC			FC		AgL
VR	Oak Creek (Unique Water)	Headwaters to confluence with unnamed tributary at 34°57'08.5"/ 111°45'13"	A&Wc				FBC		DWS	FC	AgI	AgL
VR	Oak Creek (Unique Water)	Below confluence with unnamed tributary		A&Ww			FBC		DWS	FC	AgI	AgL
VR	Oak Creek, West Fork (Unique Water)	Tributary to Oak Creek at 34°59'13"/111°44'46"	A&Wc				FBC			FC		AgL
VR	Odell Lake	34°56'02"/111°37'52"	A&Wc				FBC			FC		
VR	Peck's Lake	34°47'07"/112°02'30"	A&Wc				FBC			FC	AgI	AgL
VR	Perkins Tank	35°06'42"/112°04'08"	A&Wc				FBC			FC		AgL
VR	Pine Creek	Headwaters to confluence with unnamed tributary at 34°21'51"/ 111°26'46"	A&Wc				FBC		DWS	FC	AgI	AgL
VR	Pine Creek	Below confluence with unnamed tributary		A&Ww			FBC		DWS	FC	AgI	AgL
VR	Red Creek	Tributary to the Verde River at 34°09'47"/111°43'12"		A&Ww			FBC			FC		AgL
VR	Red Lake	35°12'19"/113°03'55"		A&Ww			FBC			FC		AgL
VR	Reservoir #1	35°13'05"/111°50'07"		A&Ww			FBC			FC		
VR	Reservoir #2	35°13'16"/111°50'36"		A&Ww			FBC			FC		
VR	Roundtree Canyon Creek	Tributary to Tangle Creek at 34°09'04"/111°48'18"		A&Ww			FBC			FC		AgL
VR	Scholze Lake	35°11'53"/112°00'31"		A&Ww			FBC			FC		AgL
VR	Spring Creek	Headwaters to confluence with unnamed tributary at 34°57'23.5"/ 111°57'19"	A&Wc				FBC			FC	AgI	AgL
VR	Spring Creek	Below confluence with unnamed tributary to Oak Creek		A&Ww			FBC			FC	AgI	AgL
VR	Steel Dam Lake	35°13'36"/112°24'51"	A&Wc				FBC			FC		AgL
VR	Stehr Lake	34°21'59"/111°40'00"		A&Ww			FBC			FC		AgL
VR	Stone Dam Lake	35°13'36"/112°24'16"	A&Wc				FBC			FC	AgI	AgL
VR	Stoneman Lake	34°46'44"/111°31'05"	A&Wc				FBC			FC	AgI	AgL
VR	Sullivan Lake	34°51'46"/112°27'41"		A&Ww			FBC			FC	AgI	AgL
VR	Sycamore Creek	Headwaters to confluence with unnamed tributary at 35°03'40"/ 111°57'28"	A&Wc				FBC			FC	AgI	AgL
VR	Sycamore Creek	Below confluence with unnamed tributary		A&Ww			FBC			FC	AgI	AgL
VR	Sycamore Creek	Tributary to Verde River at 33°37'55"/111°39'58"		A&Ww			FBC			FC	AgI	AgL
VR	Sycamore Creek	Tributary to Verde River at 34°04'42"/111°42'14"		A&Ww			FBC			FC		AgL
VR	Tangle Creek	Tributary to the Verde River at 34°05'06"/111°42'36"		A&Ww			FBC			FC	AgI	AgL
VR	Trinity Tank	35°27'44"/112°47'56"		A&Ww			FBC			FC		AgL
VR	Verde River	Above Bartlett Dam		A&Ww			FBC			FC	AgI	AgL
VR	Verde River	Below Bartlett Dam		A&Ww			FBC		DWS	FC	AgI	AgL
VR	Walnut Creek	Tributary to Big Chino Wash at 34°58'12"/112°34'55"		A&Ww			FBC			FC		AgL
VR	Watson Lake	34°35'15"/112°25'05"		A&Ww			FBC			FC	AgI	AgL
VR	Webber Creek	Tributary to the East Verde River at 34°18'50"/111°19'55"	A&Wc				FBC			FC		AgL
VR	West Clear Creek	Headwaters to confluence with Meadow Canyon at 34°33'40"/ 111°31'30"	A&Wc				FBC			FC		AgL
VR	West Clear Creek	Below confluence with Meadow Canyon		A&Ww			FBC			FC	AgI	AgL
VR	Wet Beaver Creek	Headwaters to unnamed springs at 34°41'17"/111°34'34"	A&Wc				FBC			FC	AgI	AgL
VR	Wet Beaver Creek	Below unnamed springs		A&Ww			FBC			FC	AgI	AgL
VR	Whitehorse Lake	35°07'00"/112°00'47"	A&Wc				FBC		DWS	FC	AgI	AgL
VR	Williamson Valley Wash	Headwaters to confluence with Mint Wash at 34°49'05"/ 112°37'55"			A&We			PBC				AgL

Appendix B. List of Surface Waters and Designated Uses
Abbreviations

River Basins
BW = Bill Williams
CM = Colorado Mainstem (includes Red Lake)
LC = Little Colorado
MG = Middle Gila (includes Gila River below San Carlos Indian Reservation, Salt River below Granite Reef Dam and Phoenix area waterbodies)
RM = Rios de Mexico (includes Rio Magdalena, Rio Sonoita, and Rio Yaqui Basins)
SC = Santa Cruz
SP = San Pedro
SR = Salt River (includes Salt River and tributaries above Granite Reef Dam)
UG = Upper Gila (includes Gila River and tributaries above San Carlos Indian Reservation)
VR = Verde River
WP = Wilcox Playa

Designated Uses
A&Wc = Aquatic and Wildlife cold water
A&Ww = Aquatic and Wildlife warm water
A&We = Aquatic and Wildlife ephemeral
A&Wedw = Aquatic and Wildlife effluent dependent water
FBC = Full-body Contact
PBC = Partial-body Contact
DWS = Domestic Water Source
FC = Fish Consumption
AgI = Agricultural Irrigation
AgL = Agricultural Livestock Watering

Other
U = Unique Water
EDW = Effluent-dependent Water
WWTP = Wastewater Treatment Plant
Km = kilometers

BASIN	SEGMENT	LOCATION	A&Wc	A&Ww	A&We	A&Wedw	FBC	PBC	DWS	FC	AgI	AgL
BW	Alamo Lake	34°14'45"/113°35'00"		A&Ww			FBC			FC		AgL
BW	Big Sandy River	Tributary to the Santa Maria River at 34°18'36"/113°31'34"		A&Ww			FBC			FC		AgL
BW	Bill Williams River	Tributary to the Colorado River at 34°18'04"/114°08'10"		A&Ww			FBC			FC		AgL
BW	Blue Tank	34°40'14"/112°58'16"		A&Ww			FBC			FC		AgL
BW	Boulder Creek	Headwaters to confluence with unnamed tributary at 34°41'14"/ 113°03'34"	A&Wc				FBC			FC	AgI	AgL
BW	Boulder Creek	Below confluence with unnamed tributary		A&Ww			FBC			FC	AgI	AgL
BW	Burro Creek (Unique Water)	Headwaters to confluence with Boulder Creek at 34°36'47"/ 113°18'00"		A&Ww			FBC			FC		AgL
BW	Burro Creek	Below confluence with Boulder Creek		A&Ww			FBC			FC		AgL
BW	Conger Creek	Headwaters to confluence with unnamed tributary at 34°45'13"/ 113°05'45"	A&Wc				FBC			FC		AgL
BW	Conger Creek	Below confluence with unnamed tributary		A&Ww			FBC			FC		AgL
BW	Coors Lake	34°36'20"/113°11'25"		A&Ww			FBC			FC		
BW	Copper Basin Wash	Headwaters to confluence with unnamed tributary at 34°28'11"/ 112°35'31"	A&Wc				FBC			FC		AgL
BW	Copper Basin Wash	Below confluence with unnamed tributary			A&We			PBC				AgL
BW	Cottonwood Canyon	Headwaters to Bear Trap Spring at 34°45'10"/112°52'32"	A&Wc				FBC			FC		AgL
BW	Cottonwood Canyon	Below Bear Trap Spring		A&Ww			FBC			FC		AgL
BW	Date Creek	Tributary to the Santa Maria River at 34°18'11"/113°29'53"		A&Ww			FBC			FC		AgL

Appendix A: Numeric Water Quality Criteria
Table 1. Human Health and Agricultural Designated Uses

PARAMETER	CAS* NUMBER	DWS (µg/L)	FC (µg/L)	FBC (µg/L)	PBC (µg/L)	AgI (µg/L)	AgL (µg/L)
Acenaphthene	83-32-9	420	2670	84,000	84,000	NNS	NNS
Acenaphthylene	208-96-8	NNS	NNS	NNS	NNS	NNS	NNS
Acrolein	107-02-8	3.5	25	700	700	NNS	NNS
Acrylonitrile	107-13-1	0.07	0.7	3	56,000	NNS	NNS
Alachlor	15972-60-8	2	NNS	14,000	14,000	NNS	NNS
Aldrin	309-00-2	0.002	0.0001	0.08	42	p	p
Ammonia	7664-41-7	NNS	NNS	NNS	NNS	NNS	NNS
Anthracene	120-12-7	2100	1000	420,000	420,000	NNS	NNS
Antimony (as Sb)	7440-36-0	6 T	4,300 T	560 T	560 T	NNS	NNS
Arsenic (as As)	7440-38-2	50 T	1450 T	50 T	420 T	2000 T	200 T
Asbestos	1332-21-4	a	NNS	NNS	NNS	NNS	NNS
Atrazine	1912-24-9	3	NNS	49,000	49,000	NNS	NNS
Barium (as Ba)	7440-39-3	2000 T	NNS	98,000 T	98,000 T	NNS	NNS
Benzene	71-43-2	5	140	93	93	NNS	NNS
Benzidine	92-87-5	0.0002	0.001	0.01	4,200	0.01	0.01
Benz (a) anthracene	56-55-3	0.048	0.49	1.9	1.9	NNS	NNS
Benzo (a) pyrene	50-32-8	0.2	0.05	0.2	0.2	NNS	NNS
Benzo (ghi) perylene	191-24-2	NNS	NNS	NNS	NNS	NNS	NNS
Benzo (k) fluoranthene	207-08-9	0.048	0.49	1.9	1.9	NNS	NNS
3,4-Benzofluoranthene	205-99-2	0.048	0.49	1.9	1.9	NNS	NNS
Beryllium (as Be)	7440-41-7	4 T	1,130 T	2,800 T	2,800 T	NNS	NNS
Bis (2-chloroethoxy) methane	111-91-1	NNS	NNS	NNS	NNS	NNS	NNS
Bis (2-chloroethyl) ether	111-44-4	0.03	1.4	1.3	1.3	NNS	NNS
Bis (2-chloroisopropyl) ether	108-60-1	280	174,400	56,000	56,000	NNS	NNS
Boron (as B)	7440-42-8	630 T	NNS	126,000 T	126,000 T	1000 T	NNS
Bromodichloromethane	75-27-4	TTHM	46	TTHM	28,000	NNS	NNS
p-Bromodiphenyl ether	101-55-3	NNS	NNS	NNS	NNS	NNS	NNS
Bromoform	75-25-2	TTHM	360	180	28,000	NNS	NNS
Bromomethane	74-83-9	9.8	4020	2000	2000	NNS	NNS
Butyl benzyl phthalate	85-68-7	1400	5200	280,000	280,000	NNS	NNS
Cadmium (as Cd)	7440-43-9	5 T	84 T	700 T	700 T	50 T	50 T
Carbofuran	1563-66-2	40	NNS	7,000	7,000	NNS	NNS
Carbon tetrachloride	56-23-5	5	4	11	980	NNS	NNS
Chlordane	57-74-9	2	0.002	4	700	NNS	NNS
Chlorine (total residual)	7782-50-5	700	NNS	140,000	140,000	NNS	NNS
Chlorobenzene	108-90-7	100	20,900	28,000	28,000	NNS	NNS
p-Chloro-m-cresol	59-50-7	NNS	NNS	NNS	NNS	NNS	NNS
2-Chloroethyl vinyl ether	110-75-8	NNS	NNS	NNS	NNS	NNS	NNS
Chloroform	67-66-3	TTHM	470	230	14,000	NNS	NNS
Chloromethane	74-87-3	NNS	NNS	NNS	NNS	NNS	NNS
Chloronapthalene beta	91-58-7	560	4,300	112,000	112,000	NNS	NNS

Appendix A: Numeric Water Quality Criteria
Table 1. Human Health and Agricultural Designated Uses

PARAMETER	CAS* NUMBER	DWS (µg/L)	FC (µg/L)	FBC (µg/L)	PBC (µg/L)	AgI (µg/L)	AgL (µg/L)
2-Chlorophenol	95-57-8	35	400	7,000	7,000	NNS	NNS
4-Chlorophenyl phenyl ether	7005-72-3	NNS	NNS	NNS	NNS	NNS	NNS
Chromium (as Cr III)	16065-83-1	10,500 T	1,010,000 T	2,100,000 T	2,100,000 T	NNS	NNS
Chromium (as Cr VI)	18540-29-9	21 T	2,000T	4,200 T	4,200 T	NNS	NNS
Chromium (Total as Cr)	7440-47-3	100 T	NNS	100 T	100 T	1000 T	1000 T
Chrysene	218-01-9	0.479	4.92	19.2	19	NNS	NNS
Copper (as Cu)	7440-50-8	1,300 T	NNS	1,300 T	1,300 T	5000 T	500 T
Cyanide	57-12-5	200 T	215,000 T	28,000 T	28,000 T	NNS	200 T
Dalapon	75-99-0	200	161,500	42,000	42,000	NNS	NNS
Dibenz (ah) anthracene	53-70-3	0.048	0.20	1.9	1.9	NNS	NNS
Dibromochlorometha ne	124-48-1	TTHM	34	TTHM	28,000	NNS	NNS
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	0.2	NNS	2,800	2,800	NNS	NNS
1,2-Dibromoethane (EDB)	106-93-4	0.05	NNS	0.05	0.05	NNS	NNS
Dibutyl phthalate	84-74-2	700	12,100	140,000	140,000	NNS	NNS
1,2-Dichlorobenzene	95-50-1	600	2800	126,000	126,000	NNS	NNS
1,3-Dichlorobenzene	541-73-1	NNS	NNS	NNS	NNS	NNS	NNS
1,4-Dichlorobenzene	106-46-7	75	77,500	560,000	560,000	NNS	NNS
3,3'-Dichlorobenzidine	91-94-1	0.08	0.08	3.1	3.1	NNS	NNS
p,p'-Dichlorodiphenyldic hloroethane (DDD)	72-54-8	0.15	0.001	5.8	5.8	0.001	0.001
p,p'-Dichlorodiphenyldic hloroethylene (DDE)	72-55-9	0.1	0.001	4.1	4.1	0.001	0.001
p,p'-Dichlorodiphenyltric hloroethane (DDT)	50-29-3	0.1	0.0006	4.1	700	0.001	0.001
1,1-Dichloroethane	75-34-3	NNS	NNS	NNS	NNS	NNS	NNS
1,2-Dichloroethane	107-06-2	5	100	15	280,000	NNS	NNS
1,1-Dichloroethylene	75-35-4	7	320	230	12,600	NNS	NNS
1,2-cis-Dichloroethylene	156-59-2	70	NNS	70	70	NNS	NNS
1,2-trans-Dichloroethylene	156-60-5	100	136,000	28,000	28,000	NNS	NNS
Dichloromethane	75-09-2	5	1600	190	84,000	NNS	NNS
2,4-Dichlorophenol	120-83-2	21	800	4,200	4,200	NNS	NNS
2,4-Dichlorophenoxyacet ic acid (2,4-D)	94-75-7	70	NNS	14,000	14,000	NNS	NNS
1,2-Dichloropropane	78-87-5	5	236,000	126,000	126,000	NNS	NNS
1,3-Dichloropropene	542-75-6	2	1,700	420	420	NNS	NNS
Dieldrin	60-57-1	0.002	0.0001	0.09	70	p	p
Diethyl phthalate	84-66-2	5600	118,000	1,120,000	1,120,000	NNS	NNS
Di (2-ethylhexyl) adipate	103-23-1	400	NNS	1,200	840,000	NNS	NNS
Di (2-ethylhexyl) phthalate	117-81-7	6	7.4	100	28,000	NNS	NNS
2,4-Dimethylphenol	105-67-9	140	2300	28,000	28,000	NNS	NNS

Appendix A: Numeric Water Quality Criteria
Table 1. Human Health and Agricultural Designated Uses

PARAMETER	CAS* NUMBER	DWS (µg/L)	FC (µg/L)	FBC (µg/L)	PBC (µg/L)	AgI (µg/L)	AgL (µg/L)
Dimethyl phthalate	131-11-3	NNS	NNS	NNS	NNS	NNS	NNS
4,6-Dinitro-o-cresol	534-52-1	28	7,800	5,600	5,600	NNS	NNS
2,4-Dinitrophenol	51-28-5	14	14,400	2,800	2,800	NNS	NNS
2,4-Dinitrotoluene	121-14-2	14	5,700	2,800	2,800	NNS	NNS
2,6-Dinitrotoluene	606-20-2	0.05	NNS	2	5,600	NNS	NNS
Di-n-octyl phthalate	117-84-0	2800	NNS	560,000	560,000	NNS	NNS
Dinoseb	88-85-7	7	NNS	1,400	1,400	NNS	NNS
1,2-Diphenylhydrazine	122-66-7	0.04	0.5	1.8	1.8	NNS	NNS
Diquat	85-00-7	20	NNS	3,080	3,080	NNS	NNS
Endosulfan sulfate	1031-07-8	NNS	NNS	NNS	NNS	NNS	NNS
Endosulfan (Total)	115-29-7	42	240	8,400	8,400	NNS	NNS
Endothall	145-73-3	100	NNS	28,000	28,000	NNS	NNS
Endrin	72-20-8	2	0.8	420	420	0.004	0.004
Endrin aldehyde	7421-93-3	NNS	NNS	NNS	NNS	NNS	NNS
Ethylbenzene	100-41-4	700	28,700	140,000	140,000	NNS	NNS
Ethyl chloride	75-00-3	NNS	NNS	NNS	NNS	NNS	NNS
Fluoranthene	206-44-0	280	380	56,000	56,000	NNS	NNS
Fluorene	86-73-7	280	14,400	56,000	56,000	NNS	NNS
Fluoride	7782-41-4	4000	NNS	84,000	84,000	NNS	NNS
Glyphosate	1071-83-6	700	1,077,000	140,000	140,000	NNS	NNS
Heptachlor	76-44-8	0.4	0.0002	0.4	700	NNS	NNS
Heptachlor epoxide	1024-57-3	0.2	0.0001	0.2	18	NNS	NNS
Hexachlorobenzene	118-74-1	1	0.001	1	1,120	NNS	NNS
Hexachlorobutadiene	87-68-3	0.45	50	18	280	NNS	NNS
Hexachlorocyclohexane alpha	319-84-6	0.006	0.01	0.22	11,200	NNS	NNS
Hexachlorocyclohexane beta	319-85-7	0.02	0.02	0.78	840	NNS	NNS
Hexachlorocyclohexane delta	319-86-8	NNS	NNS	NNS	NNS	NNS	NNS
Hexachlorocyclohexane gamma (lindane)	58-89-9	0.2	25	420	420	NNS	NNS
Hexachlorocyclopentadiene	77-47-4	50	580	9,800	9,800	NNS	NNS
Hexachloroethane	67-72-1	2.5	9	100	1,400	NNS	NNS
Indeno (1,2,3-cd) pyrene	193-39-5	0.048	0.49	1.9	1.9	NNS	NNS
Isophorone	78-59-1	37	2,600	1,500	280,000	NNS	NNS
Lead (as Pb)	7439-97-1	15 T	NNS	15 T	15 T	10000 T	100 T
Manganese (as Mn)	7439-96-5	980 T	NNS	196,000 T	196,000 T	10000	NNS
Mercury (as Hg)	7439-97-6	2 T	0.6 T	420 T	420 T	NNS	10 T
Methoxychlor	72-43-5	40	NNS	7,000	7,000	NNS	NNS
Naphthalene	91-20-3	140	20,500	28,000	28,000	NNS	NNS
Nickel (as Ni)	7440-02-0	140 T	4,600 T	28,000 T	28,000 T	NNS	NNS
Nitrate (as N)	14797-55-8	10000	NNS	2,240,000	2,240,000	NNS	NNS
Nitrite (as N)	14797-65-0	1000	NNS	140,000	140,000	NNS	NNS
Nitrate/Nitrite (as Total N)		10000	NNS	NNS	NNS	NNS	NNS
Nitrobenzene	98-95-3	3.5	1,900	700	700	NNS	NNS
o-Nitrophenol	88-75-5	NNS	NNS	NNS	NNS	NNS	NNS

Appendix A: Numeric Water Quality Criteria
Table 1. Human Health and Agricultural Designated Uses

PARAMETER	CAS* NUMBER	DWS (µg/L)	FC (µg/L)	FBC (µg/L)	PBC (µg/L)	AgI (µg/L)	AgL (µg/L)
p-Nitrophenol	100-02-7	NNS	NNS	NNS	NNS	NNS	NNS
N-nitrosodimethylamine	62-75-9	0.001	8	0.03	0.03	NNS	NNS
N-nitrosodiphenylamine	86-30-6	7.1	16	290	290	NNS	NNS
N-nitrosodi-n-propylamine	621-64-7	0.005	1.4	0.2	133,000	NNS	NNS
Oxamyl	23135-22-0	200	NNS	35,000	35,000	NNS	NNS
Pentachlorophenol	87-86-5	1	1000	12	42,000	NNS	NNS
Phenanthrene	85-01-8	NNS	NNS	NNS	NNS	NNS	NNS
Phenol	108-95-2	4200	1,000	840,000	840,000	NNS	NNS
Picloram	1918-02-1	500	24,300	98,000	98,000	NNS	NNS
Polychlorinatedbiphenyls (PCBs)	1336-36-3	0.5	0.007	28	28	0.001	0.001
Pyrene	129-00-0	210	10,800	42,000	42,000	NNS	NNS
Selenium (as Se)	7782-49-2	50 T	9000 T	7,000 T	7,000 T	20 T	50 T
Silver (as Ag)	7440-22-4	35 T	107,700 T	7,000 T	7,000 T	NNS	NNS
Simazine	112-34-9	4	NNS	7,000	7,000	NNS	NNS
Styrene	100-42-5	100	NNS	280,000	280,000	NNS	NNS
Sulfides		NNS	NNS	NNS	NNS	NNS	NNS
2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)	1746-01-6	0.0000003	0.000000004	0.00009	1.4	NNS	NNS
1,1,2,2-Tetrachloroethane	79-34-5	0.17	11	7	56,000	NNS	NNS
Tetrachloroethylene	127-18-4	5	3,500	14,000	14,000	NNS	NNS
Thallium (as Tl)	7440-28-0	2 T	7.2 T	112 T	112 T	NNS	NNS
Toluene	108-88-3	1000	201,000	280,000	280,000	NNS	NNS
Toxaphene	8001-35-2	3	0.001	1.3	1400	0.005	0.005
1,2,4-Trichlorobenzene	120-82-1	70	950	14,000	14,000	NNS	NNS
1,1,1-Trichloroethane	71-55-6	200	NNS	200	200	1000	NNS
1,1,2-Trichloroethane	79-00-5	5	42	25	5,600	NNS	NNS
Trichloroethylene	79-01-6	5	203,200	280,000	280,000	NNS	NNS
2,4,6-Trichlorophenol	88-06-2	3.2	6.5	130	130	NNS	NNS
2-(2,4,5-Trichlorophenoxy) proprionic acid (2,4,5-TP)	93-72-1	50	NNS	11,200	11,200	NNS	NNS
Trihalomethanes, Total		100	NNS	NNS	NNS	NNS	NNS
Uranium (as Ur)	7440-61-1	35 D	NNS	NNS	NNS	NNS	NNS
Vinyl chloride	75-01-4	2	13	2	4,200	NNS	NNS
Xylenes (Total)	1330-20-7	10000	NNS	2,800,000	2,800,000	NNS	NNS
Zinc (as Zn)	7440-66-6	2100 T	69,000 T	420,000 T	420,000 T	10000 T	25000 T

*Chemical Abstract System (CAS) number is a unique identification number given to each chemical.

Appendix A: Numeric Water Quality Criteria
Table 2. Aquatic & Wildlife Designated Uses

PARAMETER	CAS NUMBER	A&Wc Acute (µg/L)	A&Wc Chronic (µg/L)	A&Ww Acute (µg/L)	A&Ww Chronic (µg/L)	A&Wedw Acute (µg/L)	A&Wedw Chronic (µg/L)	A&We Acute (µg/L)
Acenaphthene	83-32-9	850	550	850	550	850	550	NNS
Acenaphthylene	208-96-8	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Acrolein	107-02-8	34	30	34	30	34	30	NNS
Acrylonitrile	107-13-1	3800	250	3800	250	3800	250	NNS
Alachlor	15972-60-8	2500	170	2500	170	2500	170	NNS
Aldrin	309-00-2	2.0	NNS	2.0	NNS	2.0	NNS	4.5
Ammonia	7664-41-7	b	b	b	b	NNS	NNS	NNS
Anthracene	120-12-7	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Antimony (as Sb)	7440-36-0	88 D	30 D	88 D	30 D	1000 D	600 D	NNS
Arsenic (as As)	7440-38-2	360 D	190 D	360 D	190 D	360 D	190 D	440 D
Asbestos	1332-21-4	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Atrazine	1912-24-9	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Barium (as Ba)	7440-39-3	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Benzene	71-43-2	2700	180	2700	180	8800	560	NNS
Benzidine	92-87-5	1300	89	1300	89	1300	89	10000
Benz (a) anthracene	56-55-3	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Benzo (a) pyrene	50-32-8	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Benzo (ghi) perylene	191-24-2	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Benzo (k) fluoranthene	207-08-9	NNS	NNS	NNS	NNS	NNS	NNS	NNS
3,4-Benzofluoranthene	205-99-2	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Beryllium (as Be)	7440-41-7	65 D	5.3 D	65 D	5.3 D	65 D	5.3 D	NNS
Bis (2-chloroethoxy) methane	111-91-1	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Bis (2-chlorethyl) ether	111-44-4	120000	6700	120000	6700	120000	6700	NNS
Bis (2-chloroisopropyl) ether	108-60-1	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Boron (as B)	7440-42-8	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Bromodichloromethane	75-27-4	NNS	NNS	NNS	NNS	NNS	NNS	NNS
p-Bromodiphenyl ether	101-55-3	180	14	180	14	180	14	NNS
Bromoform	75-25-2	15000	10000	15000	10000	15000	10000	NNS
Bromomethane	74-83-9	5500	360	5500	360	5500	360	NNS
Butyl benzyl phthalate	85-68-7	1700	130	1700	130	1700	130	NNS
Cadmium (as Cd)	7440-43-9	c D	c D	c D	c D	c D	c D	c D
Carbofuran	1563-66-2	650	50	650	50	650	50	NNS
Carbon tetrachloride	56-23-5	18000	1100	18000	1100	18000	1100	NNS
Chlordane	57-74-9	2.4	0.004	2.4	0.21	2.4	0.21	3.2
Chlorine (total residual)	7782-50-5	11	5.0	11	5.0	11	5.0	NNS
Chlorobenzene	108-90-7	3800	260	3800	260	3800	260	NNS
p-Chloro-m-cresol	59-50-7	15	4.7	15	4.7	15	4.7	48000
2-Chloroethyl vinyl ether	110-75-8	180000	9800	180000	9800	180000	9800	NNS
Chloroform	67-66-3	14000	900	14000	900	14000	900	NNS
Chloromethane	74-87-3	270000	15000	270000	15000	270000	15000	NNS
Chloronapthalene beta	91-58-7	NNS	NNS	NNS	NNS	NNS	NNS	NNS
2-Chlorophenol	95-57-8	2200	150	2200	150	2200	150	NNS
4-Chlorophenyl phenyl ether	7005-72-3	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Chromium (as Cr III)	16065-83-1	d D	d D	d D	d D	d D	d D	d D
Chromium (as Cr VI)	18540-29-9	16 D	11 D	16 D	11 D	16 D	11 D	34 D
Chromium (Total as Cr)	7440-47-3	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Chrysene	218-01-9	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Copper (as Cu)	7440-50-8	e D	e D	e D	e D	e D	e D	e D
Cyanide	57-12-5	22 T	5.2 T	41 T	9.7 T	41 T	9.7 T	84 T
Dibenz (ah) anthracene	53-70-3	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Dibromochloromethane	124-48-1	NNS	NNS	NNS	NNS	NNS	NNS	NNS

1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	NNS	NNS	NNS	NNS	NNS	NNS	NNS
1,2-Dibromoethane (EDB)	106-93-4	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Dibutyl phthalate	84-74-2	470	35	470	35	470	35	1100
1,2-Dichlorobenzene	95-50-1	790	300	1200	470	1200	470	5900
1,3-Dichlorobenzene	541-73-1	2500	970	2500	970	2500	970	NNS
1,4-Dichlorobenzene	106-46-7	560	210	2000	780	2000	780	6500
3,3'-Dichlorobenzidine	91-94-1	NNS	NNS	NNS	NNS	NNS	NNS	NNS
p,p'-Dichlorodiphenyldichloroethane (DDD)	72-54-8	1.1	0.001	1.1	0.02	1.1	0.02	1.1
p,p'-Dichlorodiphenyldichloroethylene (DDE)	72-55-9	1.1	0.001	1.1	0.02	1.1	0.02	1.1
p,p'-Dichlorodiphenyltrichloroethane (DDT)	50-29-3	1.1	0.001	1.1	0.001	1.1	0.001	1.1
1,1-Dichloroethane	75-34-3	NNS	NNS	NNS	NNS	NNS	NNS	NNS
1,2-Dichloroethane	107-06-2	59000	41000	59000	41000	59000	41000	NNS
1,1-Dichloroethylene	75-35-4	15000	950	15000	950	15000	950	NNS
1,2-cis-Dichloroethylene	156-59-2	NNS	NNS	NNS	NNS	NNS	NNS	NNS
1,2-trans-Dichloroethylene	156-60-5	68000	3900	68000	3900	68000	3900	NNS
Dichloromethane	75-09-2	97000	5500	97000	5500	97000	5500	NNS
2,4-Dichlorophenol	120-83-2	1000	88	1000	88	1000	88	NNS
2,4-Dichlorophenoxyacetic acid (2,4-D)	94-75-7	NNS	NNS	NNS	NNS	NNS	NNS	NNS
1,2-Dichloropropane	78-87-5	26000	9200	26000	9200	26000	9200	NNS
1,3-Dichloropropene	542-75-6	3000	1100	3000	1100	3000	1100	NNS
Dieldrin	60-57-1	2.5	0.002	2.5	0.002	2.5	0.005	4
Diethyl phthalate	84-66-2	26000	1600	26000	1600	26000	1600	NNS
Di(2-ethylhexyl) phthalate	117-81-7	400	360	400	360	400	360	3100
2,4-Dimethylphenol	105-67-9	1000	310	1000	310	1100	310	150000
Dimethyl phthalate	131-11-3	17000	1000	17000	1000	17000	1000	NNS
4,6-Dinitro-o-cresol	534-52-1	310	24	310	24	310	24	NNS
2,4-Dinitrophenol	51-28-5	110	9.2	110	9.2	110	9.2	NNS
2,4-Dinitrotoluene	121-14-2	14000	860	14000	860	14000	860	NNS
2,6-Dinitrotoluene	606-20-2	NNS	NNS	NNS	NNS	NNS	NNS	NNS
-Di-n-octyl phthalate	117-84-0	NNS	NNS	NNS	NNS	NNS	NNS	NNS
1,2-Diphenylhydrazine	122-66-7	130	11	130	11	130	11	NNS
Endosulfan sulfate	1031-07-8	0.22	0.06	0.22	0.06	0.22	0.06	3.0
Endosulfan (Total)	115-29-7	0.22	0.06	0.22	0.06	0.22	0.06	3.0
Endrin	72-20-8	0.18	0.002	0.2	0.08	0.2	0.08	0.7
Endrin aldehyde	7421-93-3	0.18	0.002	0.2	0.08	0.2	0.08	0.7
Ethylbenzene	100-41-4	23000	1400	23000	1400	23000	1400	NNS
Ethyl chloride	75-00-3	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Fluoranthene	206-44-0	2000	1600	2000	1600	2000	1600	NNS
Fluorene	86-73-7	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Fluorine	7782-41-4	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Heptachlor	76-44-8	0.52	0.004	0.52	0.004	0.58	0.013	0.9
Heptachlor epoxide	1024-57-3	0.52	0.004	0.52	0.004	0.58	0.013	0.9
Hexachlorobenzene	118-74-1	6.0	3.7	NNS	NNS	NNS	NNS	NNS
Hexachlorobutadiene	87-68-3	45	8.2	45	8.2	45	8.2	NNS
Hexachlorocyclohexane alpha	319-84-6	1600	130	1600	130	1600	130	1600
Hexachlorocyclohexane beta	319-85-7	1600	130	1600	130	1600	130	1600
Hexachlorocyclohexane delta	319-86-8	1600	130	1600	130	1600	130	1600
Hexachlorocyclohexane gamma (lindane)	58-89-9	2.0	0.08	3.4	0.28	7.6	0.61	11

Appendix C – Documents Reviewed

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